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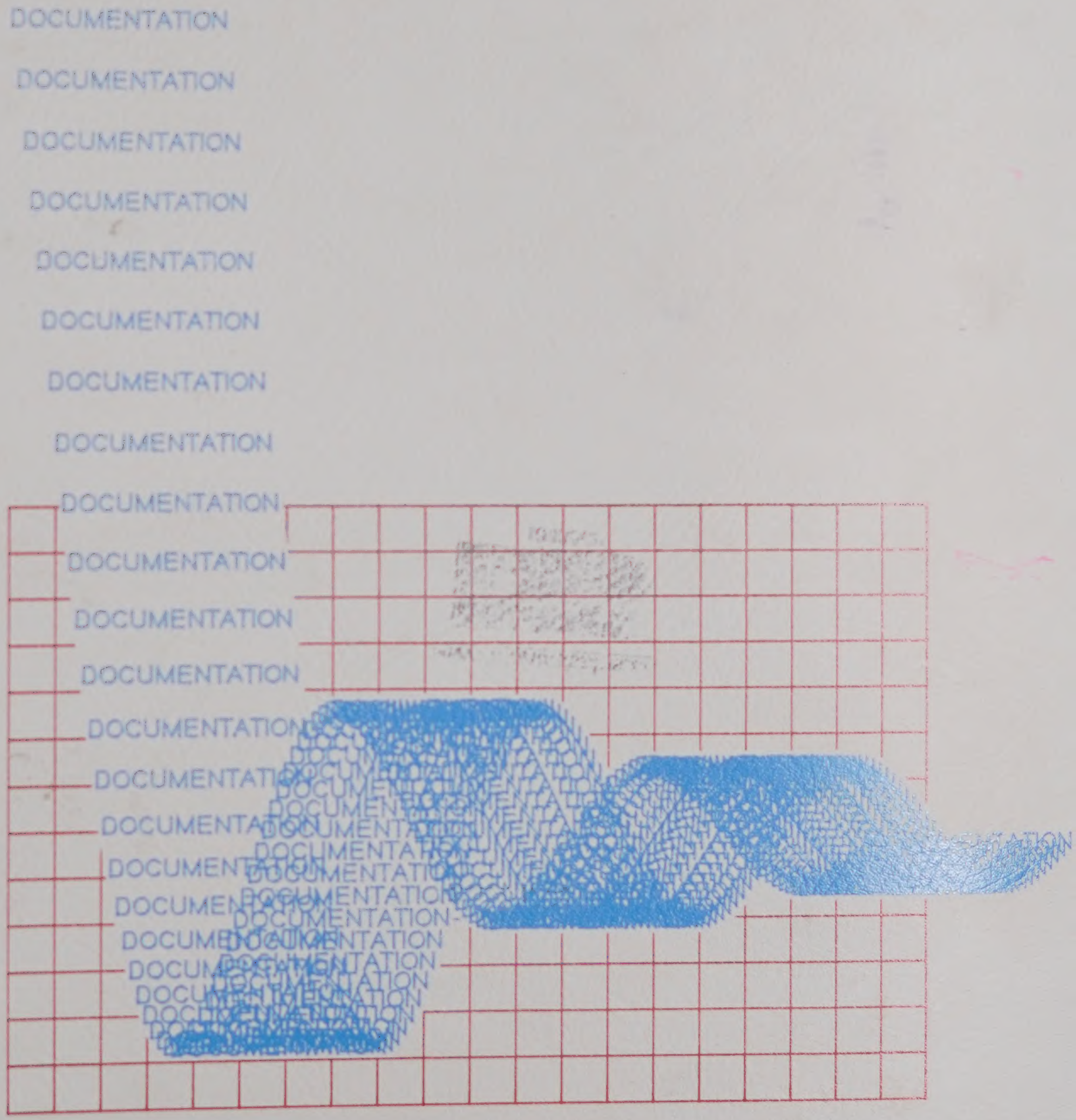

MP MASTER
MA22423

IQB14, SMIQB

< 0.5 dB

with option SMIQB17

0.6 dB,

ROHDE&SCHWARZ
Test and Measurement
Division

Operating Manual

VECTOR SIGNAL GENERATOR

SMIQ02B
1125.5555.02

SMIQ03B
1125.5555.03

SMIQ04B
1125.5555.04

SMIQ06B
1125.5555.06

Printed in the Federal
Republic of Germany

Tabbed Divider Overview

How to Use this Manual
Contents

Data Sheet
Supplement to Data Sheet

Certificate of quality
EC Certificate of Conformity
List of R & S Representatives

Tabbed Divider

1 Chapter 1: Preparation for Use

2 Chapter 2: Manual Operation

3 Chapter 3: Remote Control

4 Chapter 4: Maintenance

5 Chapter 5: Performance Test

6 Annex A: Interfaces

7 Annex B: List of Error Messages

8 Annex C: List of Commands

9 Annex D: Programming Example

10 Index

Introduction on how to use the manual

This operating manual contains essential information on commissioning, manual control, remote control, maintenance and checking the rated specifications of SMIQ as well as all specifications of the unit and available options.

The following models and options are described in this manual:

- SMIQ02B – Vector Signal Generator 300 kHz to 2.2 GHz
- SMIQ03B – Vector Signal Generator 300 kHz to 3.3 GHz
- SMIQ04B – Vector Signal Generator 300 kHz to 4.4 GHz
- SMIQ06B – Vector Signal Generator 300 kHz to 6.4 GHz

- Option SM-B1 – Reference Oscillator OCXO
- Option SM-B5 – FM/PM Modulator
- Option SMIQB11 – Data Generator
- Option SMIQB12 – Memory Extension to Data Generator
- Option SMIQB14 – Fading Simulator FSIM1
- Option SMIQB15 – Second Fading Simulator FSIM2
- Option SMIQB17 – Noise Generator and Distortion Simulator
- Option SMIQB19 – Rear Panel Connections for RF and LF
- Option SMIQB20 – Modulation Coder
- Option SMIQB42 – Digital Standard IS-95 CDMA
- Option SMIQB43 – Digital Standard W-CDMA
- Option SMIQB45 – Digital Standard 3 GPP W-CDMA
- Option SMIQB47 – LOW ACP Filter

The chapters with associated contents are as follows:

Data sheets	list guaranteed specifications for the functions and characteristics of the unit and its options.
Chapter 1	provides information on putting the unit into operation (AC supply connection, switch-on/off), functional test, preset settings, fitting the options and mounting the unit into a 19" rack.
Chapter 2	explains the **manual control** of SMIQ. It contains front and rear panel views, describes the control elements as well as connectors, provides a short introduction with sample settings for first-time users. It also explains how to change parameters and the use of the list editor and gives an overview of the menus for the functions covered by the unit and its options. It also presents the functions and menus of the unit and its options (frequency and level setting, analog and digital modulation, fading simulation, noise generation and distortion simulation, sweep, LIST mode, memory sequence and general functions not relating to signal generation).
Chapter 3	provides information on **remote control** of SMIQ. It informs about basics like IEC/IEEE bus, RS-232C interface, interface and device-dependent messages, command processing, status reporting system etc. It also includes an overview of each command system and describes all commands available in the unit and its options.

Chapter 4	informs about preventive maintenance and functional tests.
Chapter 5	contains information on how to check the rated specifications (required test equipment, test setup, test procedure) and on the performance test report.
Annex A	provides information on interfaces.
Annex B	contains a list of SCPI- and SMIQ-specific error messages displayed by the unit.
Annex C	provides an alphabetical list of commands.
Annex D	gives programming examples for remote control.
Index	provides the index with entries in alphabetical order.

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READY FOR
W-CDMA

Vector Signal Generator SMIQ

Digital signals of your choice

- Frequency range 300 kHz to 2.2 GHz/3.3 GHz/4.4 GHz/6.4 GHz
- Analog and digital modulation
- Versatile and broadband generation of digitally modulated signals up to 18 Msymbol/s
- Generation of TDMA, CDMA and W-CDMA standard signals to all main mobile radio standards
- Broadband I/Q modulator with outstanding vector accuracy
- Optional internal fading simulator to test specifications of mobile radio standards
- Optional internal noise generator and distortion simulator
- Optional BER measurement
- Lowest ACP for IS-95 CDMA and W-CDMA (option)
- Low cost of ownership due to three-year calibration intervals
- Future-oriented platform concept

ROHDE&SCHWARZ

„Ausgeklappte Seite"

The right option for every application

Application[1]	SM-B1 Reference Oscillator OCXO	SM-B5 FM/φM Modulator	SMIQB11[2] Data Generator (15 Mbit RAM)	SMIQB12 Memory Extension, 32 Mbit	SMIQB14 Fading Simulator (6 paths)	SMIQB15 2nd Fading Simulator (6 paths)	SMIQB17 Noise Generator and Distortion Simulator	SMIQB20 Digital Modulation Coder	SMIQB21[2] BER measurement	SMIQB42[3] Digital Standard IS-95 CDMA	SMIQB43[3] Digital Standard W-CDMA (NTTDoCoMo1.0, ARIB 0.0)	SMIQB45[3] Digital Standard W-CDMA according to 3GPP (FDD)	SMIQB47 Low ACP for IS-95 CDMA and W-CDM
TDMA													
To standard	○		●	○	○			●					
Non-standard	○	○	●	○	○		○	●	○				
CDMA IS-95													
To standard	○	○	●	○	○		○	●		●			
W-CDMA													
To standard	○	○	●	○	○		○	●			●	●	●
Fading													
					●	○							
Vector modulation													
	○	○	○	○	○	○	○	○		○	○	○	
Analog modulation (AM, FM, φM)													
	○	●											
Fast setting time													
	○	○	○	○	○	○	○	○		○	○	○	

[1] SMIQ02B/03B (SMIQ04B/06B) can be equipped with up to three (two) of the following options: SM-B5, SMIQB14, SMIQB15 or SMIQB17

[2] Option SMIQB20 required

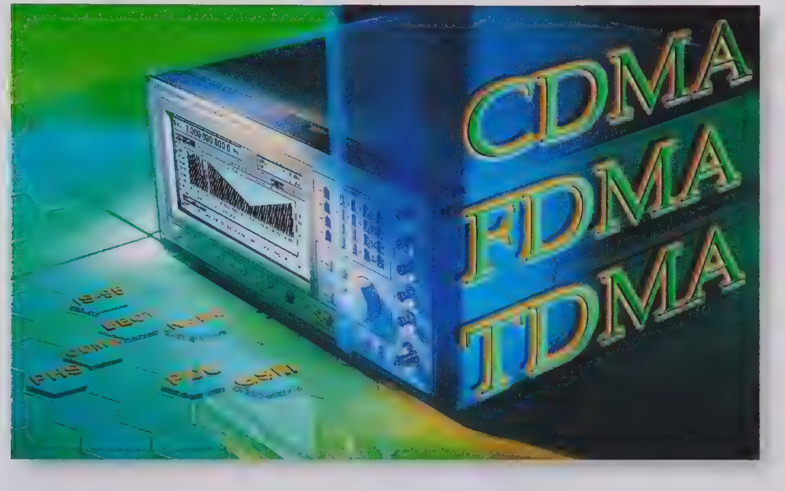
[3] Options SMIQB20 and SMIQB11 required

● = required ○ = optional

SMIQ rear panel

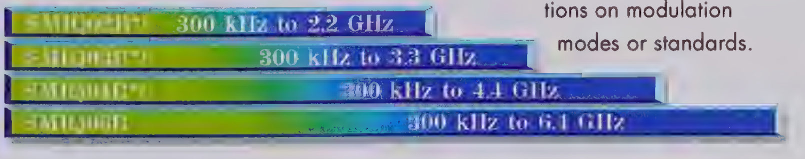
„Eingeklappte Seite"

A safe investment for the future ...



The new B series of Signal Generator Family SMIQ for analog and digital modulation from Rohde&Schwarz is offering solutions for today and tomorrow. This series particularly takes into account future developments in the field of 3rd-generation digital mobile radio.

The SMIQ family comprises four models which differ in their upper frequency limits. These feature a hitherto unrivalled versatility regarding signal generation and signal quality and are therefore ideal for use in development and type-approval testing.



With their outstanding price/performance ratio, these signal generators are also economically attractive for applications in production.

The wide frequency range from 300 kHz to 6.4 GHz covers all main radio bands including their IF ranges.

The high-grade I/Q modulator fitted as standard ensures minimum error vector magnitude and high intermodulation suppression.

Using modern digital signal processor (DSP) technology, the versatile concept allows the generation of high-precision digital modulation signals with high bit rates without any limitations on modulation modes or standards.

In addition to digital modulation, the signal generators provide the full range of analog modulation modes as well as simultaneous modulation capability.

*) Every model upgradable up to 6.4 GHz

SMIQ – a signal generator family ...

Digital modulation

Any digital modulation modes (with option SMIQB20)

- Free choice of modulation mode from ASK through to 256QAM
- Any kind of baseband filtering with variable filter parameters
- Symbol rate adjustable up to 18 Msymbol/s
- Realtime coding of internal and external data
- Internal PRBS generators

Convenient burst generation for TDMA standards (with option SMIQB20/SMIQB11)

- TDMA mobile radio standards provided as standard GSM, GSM-EDGE, DECT, NADC (IS-54C/IS-136), PDC, PHS
- Versatile external synchronization capabilities
- Realtime processing of external and internal data
- Generation of TDMA frame structures with versatile timeslot configuration
- Continuous PRBS sequences
- Optimization of burst shaping to reduce spectra due to switching
- Realtime processing with external data for BER tests
- Slot-by-slot modulation change for TDMA
- Signals with preprogrammed frame structure

Up to 79 Mbit internal data memory (with 2 x option SMIQB12)

Optional CDMA standard to IS-95 (option SMIQB42)

Optional W-CDMA standard to ARIB0.0 standard and NTTDoCoMo 1.0 (option SMIQB43)

Optional multichannel W-CDMA signals for 3GPP (FDD) systems (option SMIQB45)

Special options

Fading simulation (options SMIQB14 and SMIQB15)

- Fading of internal or external I/Q signals conforming to mobile radio standards
- 6-path simulation can be enhanced to 12-path simulation (2-channel fading also possible with second vector signal generator)
- Selectable path attenuation and delay
- Simulation of high speeds
- Preprogrammed fading profiles for mobile radio standards GSM, NADC, IS-95 CDMA and TETRA

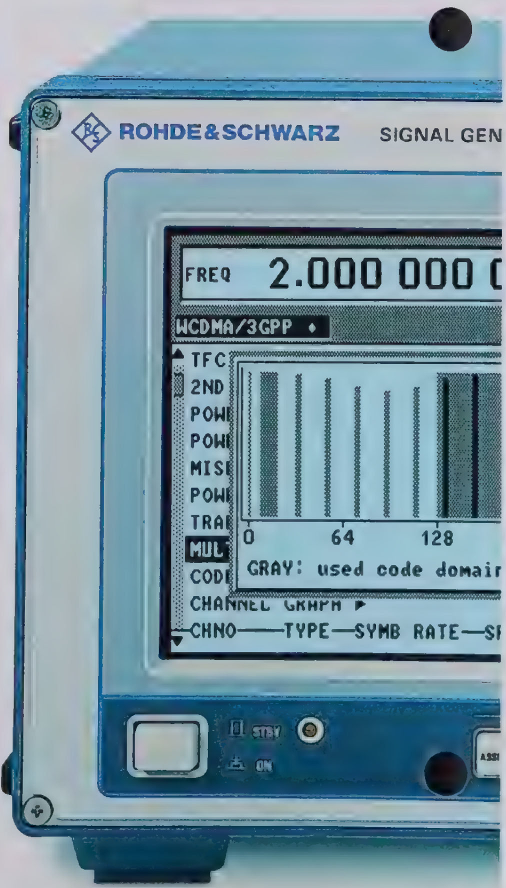
Analog modulation

- Broadband AM with up to 30 MHz modulation frequency
- I/Q modulation with 60 MHz RF bandwidth (3 dB)
- Unprecedented vector accuracy and high intermodulation suppression
- Amplitude modulation
- Pulse modulation
- Optional frequency and phase modulation (SM-B5)

RF characteristics

- Wide output frequency range from 300 kHz to 6.4 GHz
- High (up to 16 dBm) and precise output level (±0.5 dB typ.)
- Fast setting time for frequency (<3 ms) and level (<2.5 ms) *)
- Frequency hopping (500 µs)
- High spectral purity (–126 dBc/Hz at 1 GHz and 20 kHz carrier offset)
- RF, AF and level sweep (user-programmable)

*) without switching the mechanical attenuators



... for all requirements

- Frequency range of basic unit can be fully utilized
- Calibrated RF level in range from –140 dBm to –5 dBm
- Unrivalled price/performance ratio

Noise generator and distortion simulator (option SMIQB17)

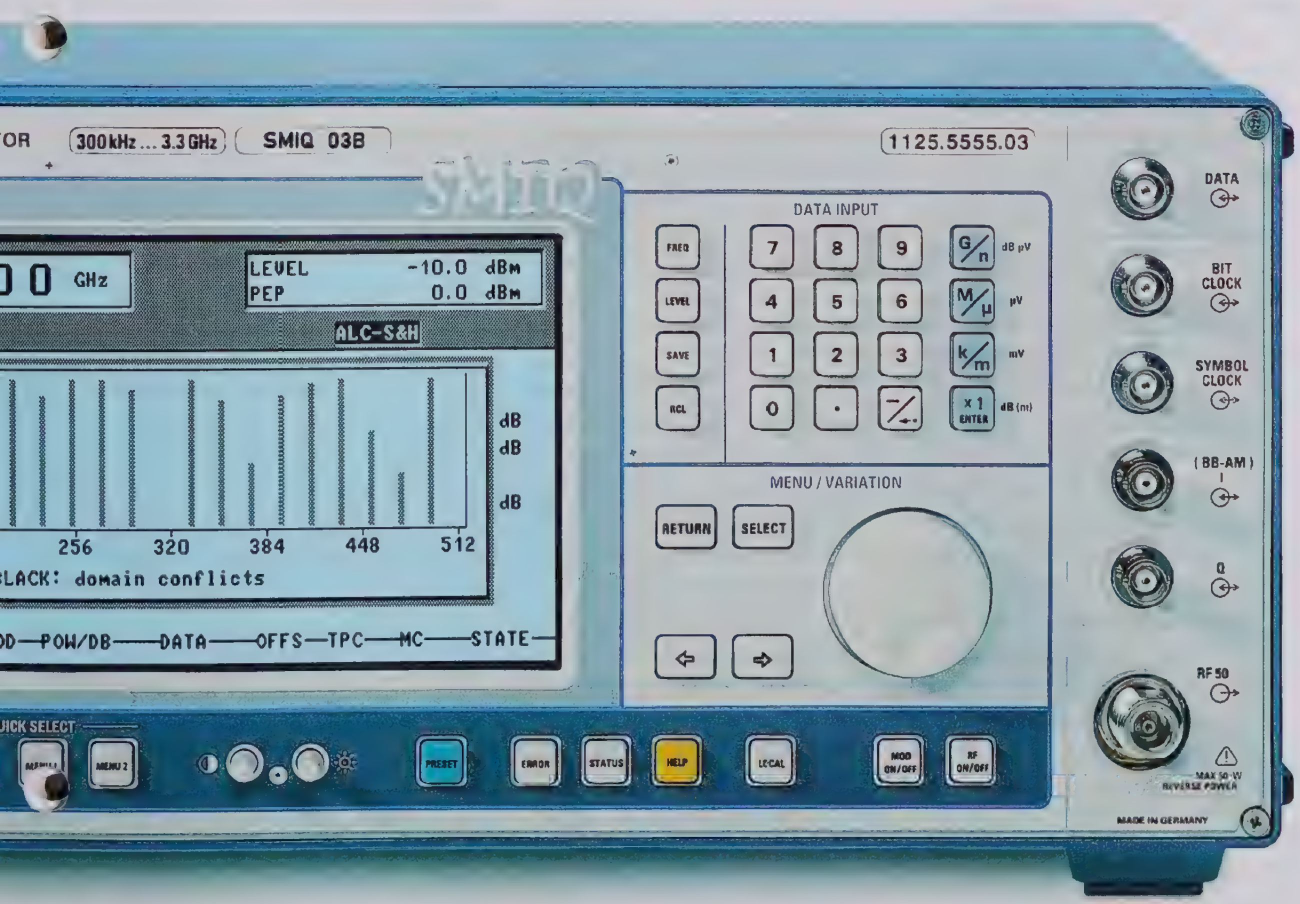
- Simulation of amplitude and phase distortion (AM/AM and AM/φM characteristics)
- Distortion characteristics programmable from up to 30 input values
- Superimposed noise signals (AWGN)
- C/N ratio variable with high resolution over a wide range
- Broad noise bandwidth (10 kHz to 10 MHz)

Bit error rate measurements (option SMIQB21)

- Up to 30 MHz clock rate

Low ACP for IS-95 CDMA and W-CDMA (option SMIQB47)

- Specially designed for 1.2288 Mcps, 4.096 Mcps and 8.192 Mcps as well as 3.840 Mcps according to 3GPP
- Can be used with internal (option SMIQB42/43/45) or external CDMA/W-CDMA signals
- Typical W-CDMA adjacent-channel power ratio (5 MHz offset, 4.096 Mcps): –67 dBc (1 DTCH)
- Typical IS-95 CDMA adjacent-channel power ratio (885 kHz offset): –78 dBc (9 code channels)



Outstanding RF characteristics

From 300 kHz to 6.4 GHz

With its wide frequency range, the SMIQ family has the right model for every application. The uppermost frequency limit of 6.4 GHz leaves sufficient margin even for WLL (wireless local loop) systems. Frequency extension options allow upgrading to higher frequency limits.

Level – high and precise

With an output level of maximum +13 dBm (+16 dBm in overrange) insertion losses caused by cables or switching matrixes can easily be compensated. For driving components with high input level the use of an external amplifier is not necessary.

A level accuracy of typ. ±0.5 dB allows high-precision measurements even on highly sensitive analog and digital receivers.

Excellent spectral purity

SMIQ provides output signals of excellent spectral purity. Low-noise frequency synthesis ensures modulation of highest quality for reliable test signals.

Fast setting times

Fast setting times are among the most important criteria when it comes to choosing the right signal generator, especially in production.

The synthesizers of the SMIQ family excel in this respect: with a frequency setting time of less than 3 ms they allow extremely fast measurements.

Besides standard sweep functions for RF, AF and level, SMIQ features an extremely versatile and fast sweep mode for frequency and level settings to be carried out with the aid of stored lists. This mode with a setting time of less than 500 µs is ideal for frequency hopping applications.

Low cost of ownership

The use of high-precision reference elements with long-term stability ensures reliable operation over a long period of time. The three-year calibration intervals cut costs and increase availability.

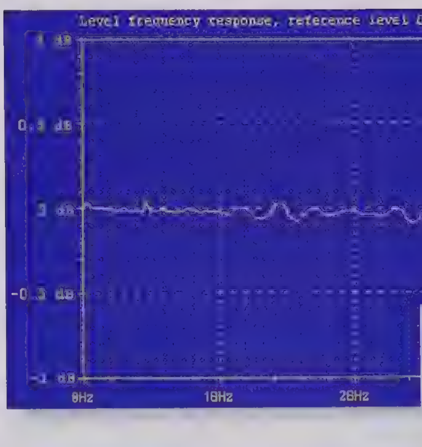
Designed for the future

The open concept of SMIQ allows the functionality of the signal generator to be adapted to future requirements in a simple and cost-effective way.

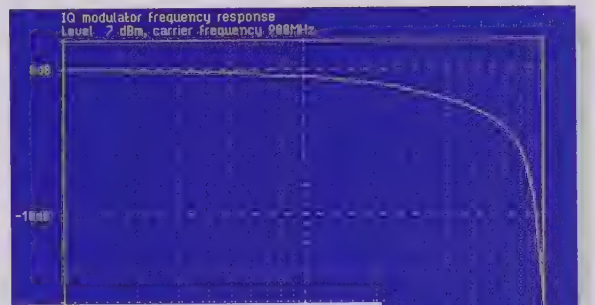
Since SMIQ uses programmable digital signal processing chips throughout, its capabilities are not limited by the hardware used.

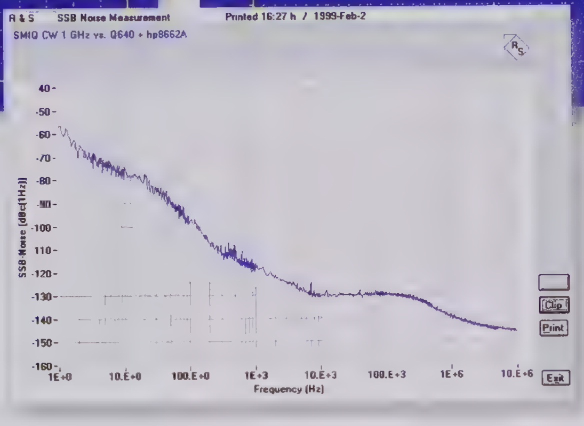
New functions can be downloaded very simply via the serial interface of the generators.

Typical level accuracy at 0 dBm



Typical I/Q frequency response





Typical SSB phase noise at f_c=1 GHz

Analog modulation

Excellent analog characteristics

SMIQ sets standards in the field of digital modulation – without any restrictions on the analog side.

Amplitude modulation
The modulation frequency range is DC to 50 kHz. Particularly noteworthy is the extremely low incidental phase modulation with AM, which plays an important role in AM sensitivity tests on FM receivers.

Frequency modulation (option SM-B5)
The modulation frequency range is DC to 2 MHz. In the FM DC mode, extremely high carrier frequency accuracy is ensured through the use of a novel control circuit. There is virtually no drift. This characteristic allows the digital signalling of receivers also by means of analog frequency modulation.

Phase modulation
Phase modulation ranges from DC to 100 kHz. This wide span opens up fields of application for which most signal generators do not qualify, for instance tests on phase-sensitive circuits or the generation of PSK modulation with freely selectable phase deviation.

IQ modulation at the highest level
The precision I/Q modulator of SMIQ is the basis for the excellent modulation characteristics with spurious suppression of more than 70 dB.

In addition to a bandwidth that is designed for the needs of future broadband systems, the modulator features high intermodulation suppression which with digital modulation yields excellent characteristics regarding adjacent-channel power.

Broadband amplitude modulation
Broadband amplitude modulation (BB-AM) is provided as standard and allows accurate envelope control (eg for pulse shaping) or generation of analog video signals. It features high modulation quality and low incidental FM at modulation frequencies of up to 30 MHz (3 dB) and is generated via the I input of the I/Q modulator.

Digital modulation

Fit for every requirement

The rapidly changing digital communications market makes great demands on measurement technology: for one thing measurements need to be done fast in an uncomplicated way, for another investments made today should cover the requirements of tomorrow. SMIQ is setting standards. It provides convenient generation of high-precision signals in line with today's digital standards and in addition allows free variation of all digital modulation parameters.

TDMA, CDMA or W-CDMA?

SMIQ is at home in all access methods. It is just as good in generating versatile frame structures of all main TDMA systems as it is in CDMA and W-CDMA applications.

Universal modulation coder

The universal modulation coder (option SMIQB20) is the core of complex digital modulation generation. From the digital input signals it derives the analog signals for the I/Q modulator of SMIQ in realtime. The internal or external digital input signals are made up of serial or parallel data bit streams, clock signals, signals for burst control and triggering. A PRBS generator of different sequence lengths is contained in the modulation coder as an internal signal source.

READY FOR
W-CDMA

The modulation coder allows free selection of the format, baseband filtering and symbol rate of digital modulation. The selected parameters can be varied within a wide range.

Three ways of generating digital signals

Vector Signal Generators SMIQ can generate digitally modulated signals in three different ways.

1. Vector modulation
In this mode, externally generated I/Q signals are applied to the I/Q modulator of SMIQ. I/Q Modulation Generator AMIQ together with Simulation Software WinIQSIM are perfect tools for the generation of external I/Q signals.

2. Digital modulation
The universal modulation coder (SMIQB20) and data generator (SMIQB11) options provide a platform for generating digitally modulated signals that are variable in a wide range. Modulation mode, filtering, data source and symbol rate can be selected by the user.

3. Digital standards
The digital standards provide at a keystroke base-station and mobile-station signals to telecommunication standards – based on the capabilities of the optional digital modulation coder (SMIQB20). The TDMA (time division multiple access) standards GSM, GSM-EDGE, DECT, NADC (IS-54C, IS-136), PDC and PHS come with the optional data generator (SMIQB11). The CDMA standard IS-95 (SMIQB42) or W-CDMA according to NTT DoCoMo systems (SMIQB43) as well as W-CDMA according to 3GPP/FDD (SMIQB45) are also available as an option. The number of future digital standards that can be simultaneously accommodated in SMIQ is unlimited.

... fit already today for tomorrow's communication

Comprehensive synchronization capabilities

The optional Data Generator SMIQB11 with a memory of 15 Mbit, which can be extended up to 79 Mbit, is the internal data source for the modulation coder. These data are also available at the outputs, eg as reference for BER (bit error rate) measurements.

Up to six different control signals can be generated synchronously with the data bits to provide symbol-accurate trigger signals, control frequency hopping and mark level bursts. With the aid of these control signals external measurements can be synchronized.

The internally generated data streams of the data generator can conveniently be synchronized to external trigger events. A comprehensive range of functions such as trigger delay is available for this purpose. The switching threshold of the trigger input can be adjusted to the level of external signals.

Convenient burst signal generation

Symbol-synchronous amplitude control of the RF signal is required especially for generating test signals for mobile radio systems using a TDMA method.

In addition to ensuring a large dynamic range, the switching of timeslots should be such that the spectrum due to switching is suppressed to a very high degree.

SMIQ is ideal to meet these requirements. Convenient menus allow timeslots to be defined independently of one another, reduced in level or completely switched off. Moreover, the slew rate and the shape of the switching signal edge can be varied.

Standards

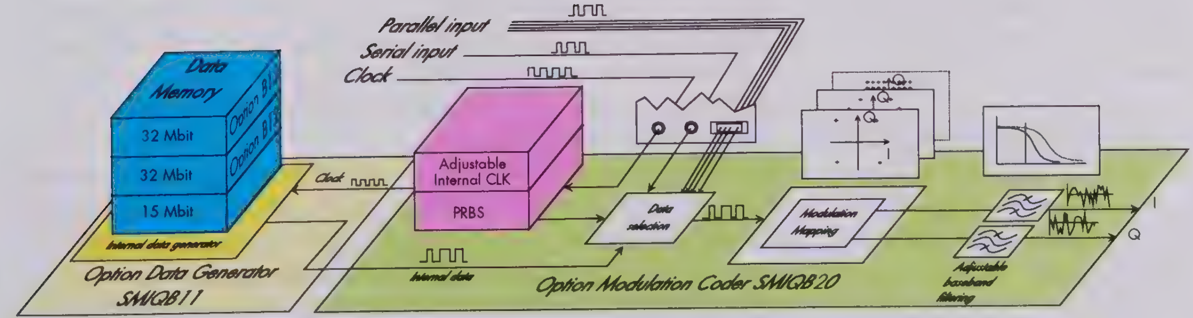
SMIQ fitted with the two options modulation coder (SMIQB20) and data generator (SMIQB11) provides standard-conformal signals for testing mobile and base stations of the main mobile radio networks. These test signals contain the necessary protocol information and frame structures for testing receivers.

The timeslots (bursts) and their data contents can be specified for the TDMA standards GSM, GSM-EDGE, DECT, NADC, PDC and PHS via user-friendly menus. The main burst types are predefined and available at a keystroke. They can easily be modified, stored and reused for tests.

Continuous PRBS data streams and internally generated data lists as well as externally provided serial data streams can be inserted in realtime into the data fields of the frame structures.

GSM Global System for Mobile Communication
Frames and timeslot configuration conform to the GSM standard. Each timeslot (burst) has a certain data structure depending on its use, eg as traffic channel or channel for frequency synchronization.

GSM-EDGE System for Mobile Communication
In comparison with GSM and GMSK modulation GSM-EDGE is based on 8PSK with $3\pi/8$ rotated modulation. Modulation change is possible slot by slot.



Principle of digital modulation signal generation

Digital modulation (continued)

DECT Digital Enhanced Cordless Telecommunication Standard

This operating mode allows signals to be generated to ETSI DECT standard.

NADC North American Digital Cellular (IS-54C, IS-136)

The data protocol structure conforms to NADC specifications IS-54C and IS-136. The following predefined burst types are available: uplink burst, downlink burst, all data.

PDC Personal Digital Cellular (RCR STD-27C)

The data protocol structure conforms to PDC specification RCR-27C. This standard is largely identical with the NADC standard.

PHS Personal Handy Phone System (RCR STD-28)

The data protocol structure conforms to PHS specification RCR-28. The following predefined burst types are provided: control physical slot, communication physical slot, sync, TCH, VOX, all data.

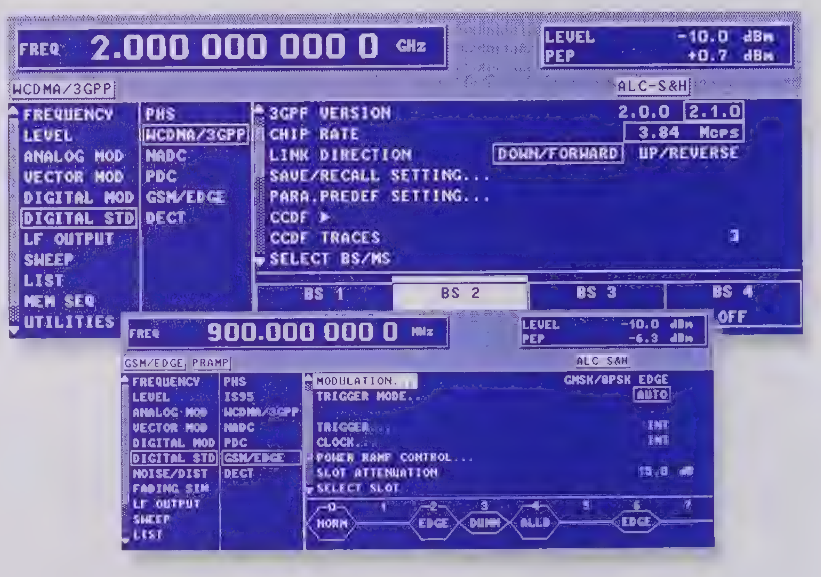
CDMA IS-95 Code Division Multiple Access (with option SMIQB42)

For the CDMA base-station signal (forward link) up to 64 code channels can be generated with user-selected Walsh codes. The power of the code channels can be selected independently for up to four channels. The channel data consist of various internal PRBS or fixed data patterns.

The mobile-station signal (reverse link) can be configured for full-rate as well as for half-rate operation. Moreover it is possible to generate a channel-coded reverse-link signal.

W-CDMA Wideband Code Division Multiple Access (with option SMIQB43)

W-CDMA – a "standard" currently still in the definition phase – is one of the favoured technologies for the 3rd mobile radio generation.



FREQ 2.000 000 000 0 GHz
LEVEL -10.0 dBm
PEP +0.7 dBm
WCDMA/3GPP
ALC-S&H
3GPP VERSION 2.0.0 2.1.0
CHIP RATE 3.84 Mcps
LINK DIRECTION DOWN/FORWARD UP/REVERSE
CCDF TRACES 3
BS 4 OFF

FREQ 900.000 000 0 MHz
LEVEL -10.0 dBm
PEP -6.3 dBm
GSM/EDGE, PRAMP
ALC S&H
MODULATION... GMSK/8PSK EDGE
TRIGGER MODE... AUTO
TRIGGER... INT
CLOCK... INT
SLOT ATTENUATION 15.0 dB

Fitted with option W-CDMA (SMIQB43), SMIQ is able to generate W-CDMA signals to the Japanese specifications of NTT DoCoMo and ARIB[1].

Like with IS-95 CDMA, uplink (mobile station to base station) and downlink (base station to mobile station) can be simulated with up to 15 code channels. A chip rate of 4.096 Mcps is preset, but can be varied any time.

There is a choice of different types of physical channels, such as perch, common control or dedicated physical channels. The frame structure consisting of various data fields (traffic power control or long code mask symbol) is automatically generated for each type of channel.

Digital Standard W-CDMA 3GPP/FDD (with option SMIQB45)

Software option SMIQB45 supports the generation of downlink and uplink signals in line with the 3GPP standard (FDD mode). As the standardization process is not yet completed, the functionality of this option will continuously be adapted to the relevant standard modifications and expansions (for functionality see specifications).

The physical channels including their slot structure are simulated as a whole. Therefore the signals exactly conform to the 3GPP standard regarding timing, spectral distribution and amplitude probability distribution and thus allow correct measurements on the components to be tested.

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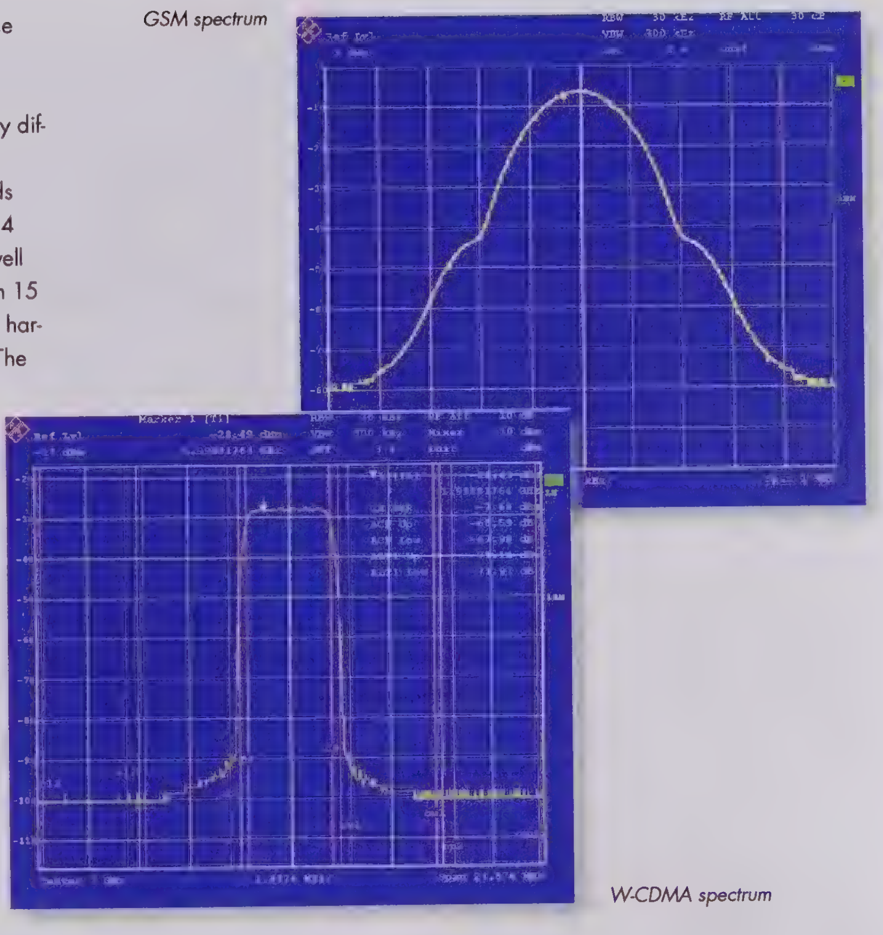
[1] Association of Radio Industries and Businesses (ARIB), Specifications of Air Interface for a 3 G Mobile System

Signals can be configured in many different ways:

- The software supports standards with 4.096, 8.192 and 16.384 Mcps and 16 slots/frame as well as the 3.840 Mcps system with 15 slots/frame in line with the 3G harmonization recommendation. The maximum number of data channels is 512
- Up to four base stations or mobile stations with 128 code channels each and with separately selectable T_{sector} and long code initial value, different power of the SCH, etc, can be simulated
- Symbol rate, spreading code, power, data contents (various PRBS or bit patterns) and data offset can be selected for each code channel (data offset is a time offset that can be used to influence the crest factor)
- Perch channels, SCCPCH and DPCHs can be generated in the downlink, PRACH, DPCCH and DPDCHs in the uplink, each channel with its specific slot structure
- The TPC bits may be used for varying the transmit power of a channel versus time
- The downlink signals can be calculated for antenna 1 or 2 (transmit diversity)
- The long signal length of up to 13 frames (with 3.84 Mcps) allows realistic signals to be generated



GSM spectrum

W-CDMA spectrum

Despite the large variety of functions provided by this option, W-CDMA signals can quickly be generated with the aid of assistant functions. With the aid of predefined settings which may additionally be varied through the selection of the crest factor and the number of data channels a W-CDMA signal can be generated with a few keystrokes. Further editing tools allow simultaneous configuration of numerous data channels and copying of a complete BS or MS configuration.

But there is much more. SMIQ also provides numerous tools for checking the selected settings: overlapping of individual code channels in the code domain (domain conflicts) are displayed and can even be eliminated automatically upon a keystroke. The graphical display of constellation diagram, CCDF, occupied code domain and active channels allows the generated signals to be checked for conformance to expectations even without the use of an analyzer.

Special options

Fading simulation – options SMIQB14/B15

With the optional fading simulator, the SMIQ models are the first signal generators allowing tests that correspond to the capabilities of conventional simulators. Fading is thus no longer a matter of highly specialized measurement technology.

Fading simulation in SMIQ is based on the WSSUS (wide sense stationary uncorrelated scattering) model and meets the test specifications of all main mobile radio standards, such as GSM Rec. 05.05. Both internal and external I/Q baseband signals are provided with defined multipath propagation factors through digital signal processing. Conversion to the RF with calibrated level setting is made with the available hardware of SMIQ.

6-path fading with SMIQB14
Option SMIQB14 allows realistic simulation of a received signal that is composed of up to 6 propagation paths, irrespective of the selected modulation mode, with RF bandwidths of up to 14 MHz (3 dB).

Each of the 6 propagation paths can be individually parameterized in a wide range.

Why fading tests?

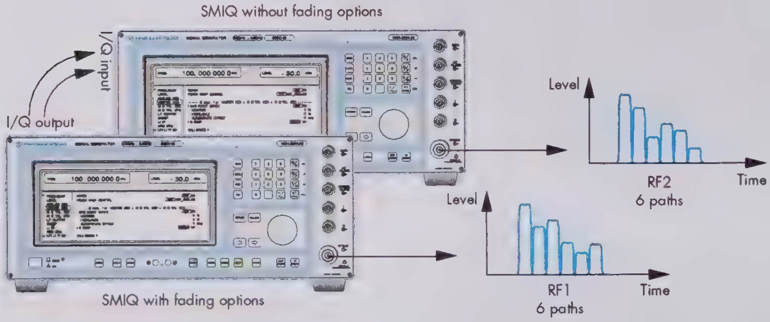
Short-time signal fading, as caused by multipath propagation, strongly affects the error rate of the received signal due to the short symbol periods in digital mobile radio

Modern digital systems overcome these problems with the aid of appropriate error control coding methods as well as algorithms for delay equalizing.

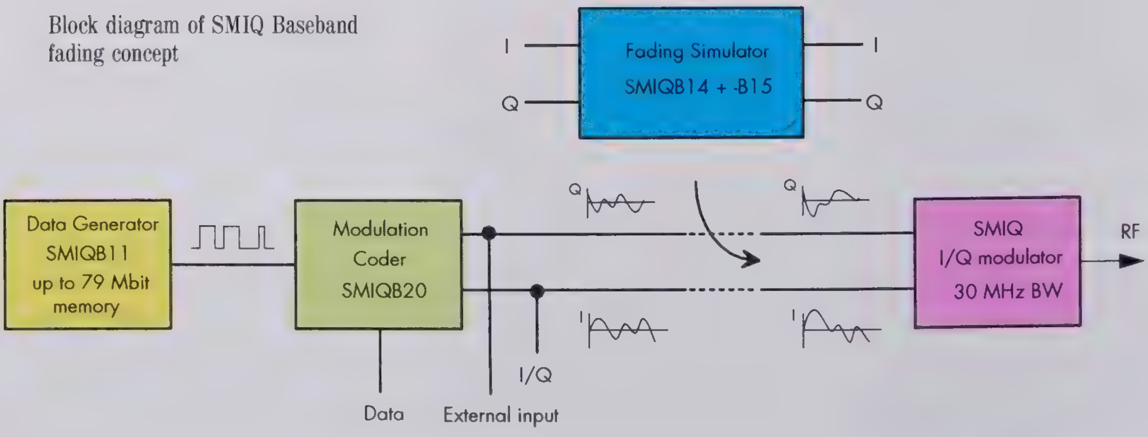
Interleaving is employed to overcome the problem of losing large parts of the messages.

Resistance to fading is an essential quality criterion of digital mobile radio systems and means a considerable competitive advantage for the manufacturer.

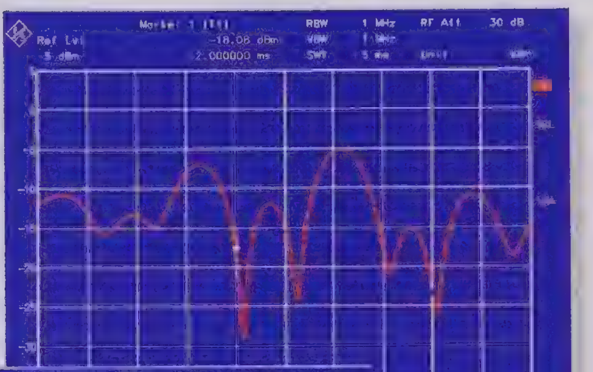
Tests with real-world signals using fading simulators are a must to spot the weak points in new concepts at an early stage so that appropriate modifications can be made.

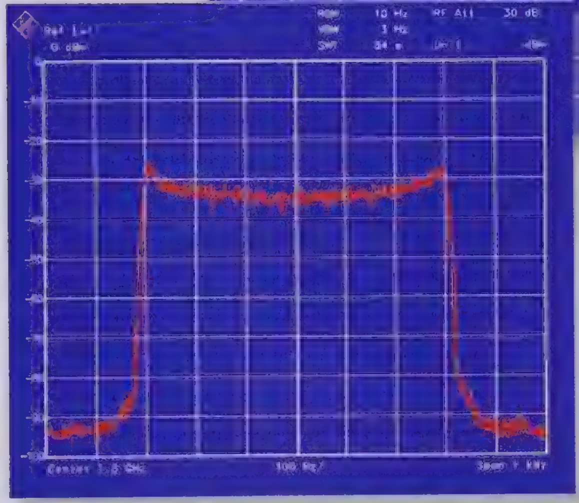


Block diagram of SMIQ Baseband fading concept



Typical Rayleigh fading profile





Rayleigh fading (Doppler spectrum), generated at a speed of 180 km/h (RF = 1.8 GHz)

Rayleigh, Rice and lognormal fading profiles can individually be selected for each path. Attenuation, delay and speed can also be set for each propagation path.

In addition to the individual configuration, preprogrammed settings in line with the test specifications of mobile radio standards (GSM, NADC, IS-95 CDMA and TETRA) can be recalled at a keystroke, which ensures great operating convenience.

12-path fading with SMIQB15

Option SMIQB15 provides another 6 paths for fading, which can be parameterized exactly as the first 6 paths, to give a total of 12 paths.

2-channel fading (6 paths per channel)

For testing base-station receivers with two separate antenna inputs (diversity), the I/Q output signals of options SMIQB14 and -B15 can be separated in the (6+6)-path fading mode.

While the I/Q signals of the first fading simulator (option SMIQB14) are used for driving the internal I/Q modulator, the second fading option (SMIQB15) is used to feed a second vector signal generator. In this mode, the individual propagation paths of the two options can be correlated with each other one by one in pairs.

Advantages of the SMIQ fading concept

- **Unrivalled price/performance ratio**
  For the first time, fading in a quality corresponding to that of a high-grade simulator is available at a fraction of the costs previously involved.
- **Compact**
  With this concept, neither external RF signals nor a LO signal are required to simulate fading, so that simulation is simply a compact one-box solution.
- **Versatile with calibrated output levels**
  SMIQ fading capability can be used without any restriction on the frequency and level range of the signal generator (–140 to –5 dBm). The user can define and store his own fading scenarios.
- **Easy to operate**
  Preprogrammed settings in line with the test specifications of mobile radio standards can be recalled at a keystroke. Tests can be carried out easily and rapidly.

Special options (continued)

Noise generation and distortion simulation – SMIQB17

Real signals

A signal generator is normally used to generate as near as possible ideal signals. For testing receivers, it is however also necessary to simulate real transmitting and receiving conditions. This is exactly what option SMIQB17 has been designed for.

Noise generator

With the aid of the noise generator, an additive white Gaussian noise (AWGN) signal can be superimposed on the output signal of SMIQ. The ratio of carrier power to noise power (C/N) can be varied with high resolution over a wide range. This allows for instance precise sensitivity measurement of receiver circuits with defined C/N.

Distortion simulator

The distortion simulator allows simulation of amplitude and phase distortion (eg of a travelling wave tube in a satellite output stage). All that has to be done is to enter via the IEC/IEEE bus the input values of the AM/AM and AM/φM characteristics to be simulated. The complete characteristics forming the basis for nonlinear distortion of the I/Q baseband signals are calculated by means of spline interpolation. It is possible to distort I/Q signals irrespective of whether they are generated by the internal modulation coder or applied from an external source.

Digital signal processing in the baseband (I and Q signals) is used both for the generation of the AWGN signal and distortion of the output signal. This ensures high accuracy and excellent reproducibility of measurements.

Versatile applications

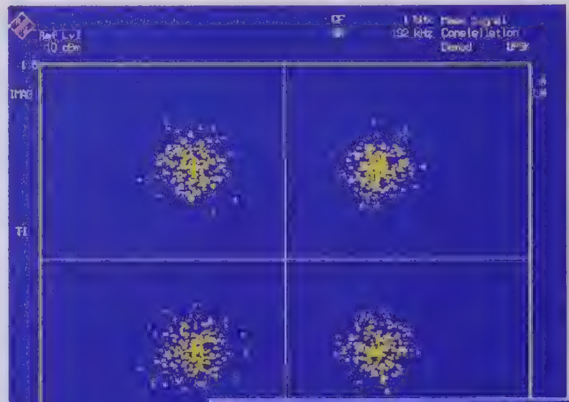
Distortion simulation and additive noise can be combined with the following SMIQ functions: vector modulation, digital modulation, digital standards and fading simulator.

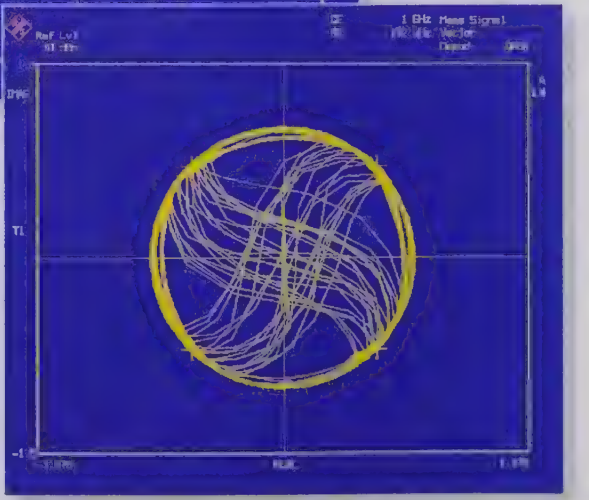
The method in detail

The distortion characteristics are internally represented by 2000 interpolation points which are determined by cubic spline interpolation from up to 30 input values. Several distortion characteristics can be stored under user-defined names and recalled. AM/AM and AM/φM distortion may also be defined by entering polynomial coefficients up to the fifth order.

Inverse polynomials can be selected for compensating the distortion of an external amplifier. The noise bandwidth can be varied in a wide range.

Constellation diagram of noisy QPSK signal





Vector diagram of distorted modulation signal

Low ACP for IS-95 CDMA and W-CDMA – SMIQB47

Challenging test requirements

Modern communications systems that are based on access methods like CDMA or W-CDMA place demanding requirements on terminals and components.

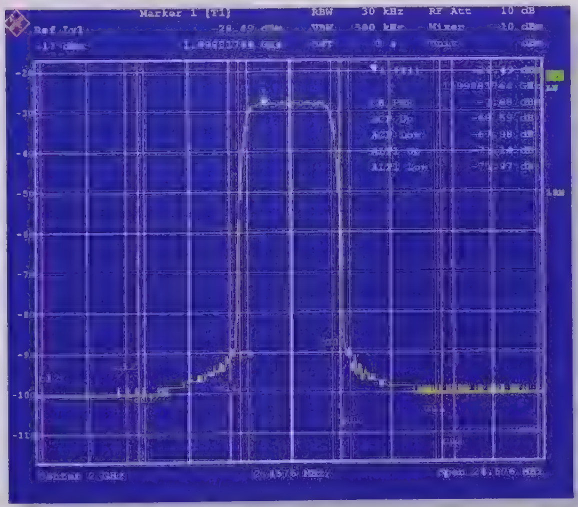
For testing components (eg base-station power amplifier) that are used in such systems special test sources with outstanding characteristics regarding adjacent-channel power ratio (ACPR) are required. The measurement equipment used should cause as little interference as possible.

ACPR – unrivalled low

The extraordinarily low ACPR of the basic SMIQ unit is made possible by the built-in high-grade I/Q modulator. In conjunction with option SMIQB47 providing additional filtering in the I/Q signal path, SMIQ becomes an ideal signal source suited to meet the most stringent requirements. This option has especially been designed for IS-95 CDMA (1.2288 Mcps) and W-CDMA (3.840 Mcps and 4.096 Mcps/8.192 Mcps respectively) and, with adjacent-channel power reduction, provides sufficient measurement margin for characterizing and testing components (eg amplifiers).

The adjacent-channel power ratio for a W-CDMA signal with one DTCH (dedicated traffic channel) is typically –67 dBc[1]. For IS-95 CDMA the typical adjacent-channel power ratio is –78 dBc[2].

Option SMIQB47 can be used both with internal signals of the modulation coder (SMIQB20) or with an external I/Q source (eg AMIQ).



ACP measurement for a W-CDMA signal with option SMIQB47

Fast CPU

Fit for production

Time is money! SMIQ is equipped with a fast CPU for applications in production where complete test runs should take no more than a few seconds.

This CPU reduces the standard setting times for frequency and level to 3 ms (without switching the mechanical attenuators) to provide maximum throughput and so ensures competitiveness and economy of the production line.

BER measurement - SMIQB21

Measuring the bit error rate has become a frequently used method for the verification of digital communication systems (eg measuring the sensitivity or selectivity of receivers, subsystems and components). The retrofittable option (SMIQB21) allows SMIQ to be used for these BER (**b**it-**e**rror-**r**ate) measurements. The device under test (DUT) has to deliver the data to be tested and the associated clock. If the DUT does not have its own clock, it can be generated by SMIQ and output via bit and/or symbol clock. The built-in BER tester compares these data with the nominal data and calculates the error rate. Various standard PRBS sequences (PN9, PN15, etc) are used as nominal data. The result of the BER measurement is also available via the remote-control interface.

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[1] 4.096 MHz bandwidth, 5 MHz offset, 2.5 MHz I/Q filter

[2] 9 channels, 885 kHz offset, 850 kHz I/Q filter

Applications

Type-approval testing of digital base and mobile stations
Mobile and base stations are complex systems, where signal generators are used for testing out system parts such as receivers, modulators and amplifiers. Due to its versatility and signal quality, SMIQ is ideally suited to handle these tasks.

Sensitivity measurements on digital receivers
Sensitivity measurements on digital receivers require high modulation quality as well as precise level setting over a wide range.

Due to the losses in automatic test systems – caused by cables and the use of power splitters, relays, attenuators, etc – the absolute level accuracy is less important than the reproducibility of the settings. SMIQ yields excellent values in this respect.

Frame structures with defined data contents for BER measurements are made available by programmed standard settings.

Selectivity measurements on digital receivers
Low phase and broadband noise, high spurious suppression of >70 dB even with activated digital modulation as well as excellent adjacent-channel power ratios make SMIQ an ideal source for selectivity measurements on digital receivers.

Base-station transmitter test
For testing base-station transmitters, SMIQ is able to supply the data signals of the internal data generator (DATA, DATA CLK, SYMB CLK) as well as the analog I/Q baseband signals.

Testing of equalizers
The optional fading simulator for SMIQ is ideal for testing the equalizers of digital receivers. While conventional fading simulators need external RF input signals, SMIQ generates its own modulated RF signal. New equalizer concepts can thus be tested at a very early stage in development.

Tolerance tests on digital systems
In addition to ideal signals, SMIQ also allows the generation of signals with

SMIQ in TETRA simulator

Module test with SMIQ, AMIQ and Signal Analyzer FSIQ

defined degradations (I/Q impairments or noise and distortion with option SMIQB17) as well as the variation of bit rates and filtering to determine tolerance limits and to detect potential critical spots in new systems.

Components tests

The high setting speed and modulation quality make SMIQ supreme for use in the development and production of digital components and modules.

The high intermodulation suppression of the I/Q modulator of SMIQ ensures excellent adjacent-channel power ratios of the modulated output signal for conclusive linearity measurements on amplifier components.

The high spurious suppression of >70 dB of the SMIQ output signal allows accurate measurements on mixer components.

Development of new digital communication systems

SMIQ offers all capabilities that are required for developing new digital communication systems.

Featuring a bandwidth of 30 MHz (–3 dB), the I/Q modulator of SMIQ is ideally suited for future broadband systems.

The optional modulation coder allows any digital modulation modes – from BPSK through to 256QAM – to be generated with variable data rate and baseband filtering.

With the maximum symbol rate of 18 Msymbol/s broadband digital modulation modes can be generated. Any TDMA structures can be produced with the aid of a programmable burst generator.

The modulation coder of SMIQ is already equipped for future applications, eg in the field of broadband spread-spectrum systems (wireless local loop, wireless LAN).

SMIQ meets already today the challenges of tomorrow's market.

Ordering information

Vector Signal Generator

SMIQ02B	(300 kHz to 2.2 GHz)	1125.5555.02
SMIQ03B	(300 kHz to 3.3 GHz)	1125.5555.03
SMIQ04B	(300 kHz to 4.4 GHz)	1125.5555.04
SMIQ06B	(300 kHz to 6.4 GHz)	1125.5555.06

Accessories supplied	power cable, operating manual

Options

Reference Oscillator OCXO	SM-B1	1036.7599.02
FM/φM Modulator	SM-B5	1036.8489.02
Data Generator	SMIQB11	1085.4502.04
Memory Extension, 32 Mbit	SMIQB12	1085.2800.04
Fading Simulator, 6 paths	SMIQB14	1085.4002.02
Second Fading Simulator for 12 paths or 2 channels	SMIQB15	1085.4402.02
Noise Generator and Distortion Simulator	SMIQB17	1104.9000.02
RF and AF Rear Connectors	SMIQB19	1085.2997.02
Modulation Coder	SMIQB20	1125.5190.02
BER Measurement	SMIQB21	1125.5490.02
Digital Standard IS-95 CDMA	SMIQB42	1104.7936.02
Digital Standard W-CDMA acc. to NTTDoCoMo 1.0, ARIB 0.0 standard	SMIQB43	1104.8032.02
Digital Standard W-CDMA acc. to 3GPP (FDD)	SMIQB45	1104.8232.02
Low ACP for IS-95 CDMA and W-CDMA	SMIQB47	1125.5090.02
Modification Kit for Low ACP (factory installation only)	SMIQU47	1125.5149.02

Additional hint: SMIQ02B/03B (SMIQ04B/06B) can be equipped with up to three (two) of the following options: SM-B5, SMIQB14, SMIQB15, SMIQB17

Recommended extras

19" Adapter	ZZA-94	0396.4905.00
Service Kit	SM-Z3	1085.2500.02
BNC Adapter for rear panel, D type connector PAR DATA	SMIQ-Z5	1104.8555.02
90° Power Splitter	SMIQ-Z9	1104.9580.02
Trolley for Transit Case	ZZK-1	1014.0510.00
Transit Case	ZZK-944	1013.9366.00
Service Manual SMIQ		1085.2445.24

Instrument upgrades

SMIQ02B to SMIQ03B	SMIQU03	1125.5855.03
SMIQ03B to SMIQ04B	SMIQU04	1125.5855.04
SMIQ04B to SMIQ06B	SMIQU06	1125.5855.06

Specifications see separate data sheet PD 757.4582.22

Certified Quality System
ISO 9001
DQS REG. NO 1954-04

ROHDE&SCHWARZ

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READY FOR
W-CDMA

Specifications for Vector Signal Generator SMIQ*)

*) see data sheet PD 757.2438.24

valid from 10/99

ROHDE&SCHWARZ

RF features

Frequency

Range	
SMIQ02B	300 kHz to 2.2 GHz
SMIQ03B	300 kHz to 3.3 GHz
SMIQ04B	300 kHz to 4.4 GHz
SMIQ06B	300 kHz to 6.4 GHz
Resolution	0.1 Hz

Setting time to within $<1\times10^{-7}$ for f>450 MHz and <240 Hz for f<450 MHz after IEC/IEEE-bus delimiter with ALC MODE set to ON or ALC OFF MODE set to TABLE

Normal operation	
f ≤ 3.3 GHz	<3 ms
f > 3.3 GHz	<3.3 ms
After trigger pulse in list mode	
f ≤ 3.3 GHz	<500 µs
f > 3.3 GHz	<700 µs
Phase offset	adjustable in steps of 0.1°

Reference frequency

	Standard	**Option SM-B1**
Aging (after 30 days of operation)	1×10^{-6}/year	$<1\times10^{-9}$/day
Temperature effect (0°C to 50°C)	2×10^{-6}	$<5\times10^{-8}$
Warm-up time		≤15 min
Output for internal reference		
Frequency	10 MHz	
Level V_{rms} (EMF, sinewave)	1 V	
Source impedance	50 Ω	
Input for external reference		
Frequency	1 MHz to 16 MHz in 1 MHz steps	
Permissible frequency drift	3×10^{-6}	
Input level	0.1 V to 2 V rms	
Input impedance	200 Ω	
Electronic tuning (EXT. TUNE)	1×10^{-7}/V	
Input voltage range	0 V to ±10 V	
Input impedance	10 kΩ	

Level

Range		
SMIQ02B/03B	–144 dBm to +13 dBm (PEP) 1)	
SMIQ04B/06B	–144 dBm to +10 dBm (PEP) 1)	
Overranging without guarantee of specs	up to16 dBm	
Resolution	0.1 dB or 0.01 dB	
Total level uncertainty >–127 dBm 2) 14)		
f ≤2 GHz	<±1 dB (typ. <±0.5 dB)	
f >2 GHz to 4 GHz	<±1.5 dB (typ. <±0.9 dB)	
f >4 GHz to 6 GHz	<±2 dB (typ. <±1.2 dB)	
f >6 GHz	<±2.5 dB	
Frequency response at 0 dBm 2) 14)		
f up to 3.3 GHz	<1 dB, typ. <0.3 dB	
f >3.3 GHz	<±1.5 dB, typ. < ±0.5 dB	
Output impedance	50 Ω	
VSWR	f ≤2.2 GHz	2.2 GHz < f ≤ 6.4 GHz
max. level	<1.8	<2.0
≤–3 dBm	<1.5	<1.5
Setting time (IEC/IEEE bus) CW, analog modulation	<25 ms with mechanical attenuator <2.5 ms without mechanical attenuator	
Non-interrupting level setting		
FIXED mode	setting range >20 dB	
ELECTRONIC mode	setting range >80 dB	
Overload protection	protects the unit from externally applied RF power (from 50 Ω source) and DC voltage	
Max. permissible RF power	50 W	
Max. permissible DC voltage	35 V	

Spectral purity2)

Spurious	
Harmonics at levels ≤10 dBm (SMIQ02B/03B) at levels ≤7 dBm (SMIQ04B/06B)	<–30 dBc
Nonharmonics	
CW, carrier offset >10 kHz	
0.3 to 450 MHz	<–74 dBc
>450 to 1500 MHz	<–80 dBc
>1500 to 3000 MHz	<–74 dBc
>3000 MHz to 3300 MHz	<–60 dBc
>3300 MHz	as with vector modulation
Vector modulation,	
carrier offset 10 kHz to < 300 MHz	
0.3 MHz to 3300 MHz	<–70 dBc
carrier offset ≥300 MHz	
0.3 MHz to 3300 MHz	<–60 dBc
carrier offset 10 kHz to < 900 MHz	
>3300 MHz to 6000 MHz	<–64 dBc
>6000 MHz	<–58 dBc
carrier offset ≥900 MHz	
>3300 MHz, ≥5 dBm	<–50 dBc
Broadband noise, CW, carrier offset >5 MHz	
f >20 MHz to 450 MHz	<–136 dBc (typ. –142 dBc)
f >450 MHz to 3040 MHz	<–138 dBc (typ. –144 dBc)
f >3040 MHz to 3300 MHz	<–136 dBc (typ. –142 dBc)
f >3300 MHz to 6400 MHz	<–132 dBc (typ. –138 dBc)

Broadband noise, vector modulation, f >20 MHz, carrier offset >5 MHz	<–131 dBc (typ. –137 dBc)	
SSB phase noise, carrier offset 20 kHz, 1 Hz bandwidth	CW	Vector/dig. mod.
f = 20 MHz to 450 MHz	<–116 dBc	<–119 dBc
f = 1 GHz	<–126 dBc	<–123 dBc
f = 2 GHz	<–120 dBc	<–120 dBc
f = 3 GHz	<–116 dBc	<–116 dBc
f = 6 GHz	<–110 dBc	<–110 dBc
Residual FM, rms (f = 1 GHz)		
0.3 to 3 kHz (ITU-T)	<1 Hz	
0.03 to 20 kHz	<4 Hz	
Residual AM, rms (0.03 to 20 kHz)	<0.02%	

Sweep

RF sweep, AF sweep	digital sweep in discrete steps
Modes	automatic, single shot, manual or external trigger, linear or logarithmic
Sweep range	user-selectable
Step width (lin)	user-selectable
Step width (log)	0.01 to 100%
Level sweep	
Modes	automatic, single shot, manual or external trigger, logarithmic
	0.1 dB to 20 dB
Sweep range	0.1 dB to 20 dB
Step width (log)	
Step time	10 ms to 1 s
Resolution	0.1 ms
Markers	3, user-selectable
MARKER output signal	TTL level (HCT), selectable polarity
X output	0 V to 10 V
BLANK output signal	TTL level (HCT), selectable polarity

Internal modulation generator

Frequency range	0.1 Hz to 1 MHz
Resolution	0.1 Hz
Frequency drift	$<1\times10^{-4} + 0.012$ Hz
Frequency response up to 100 kHz	<0.4 dB
Frequency response up to 1 MHz	<2 dB
Distortion up to 100 kHz (R_L >200 Ω, peak level 1 V)	<0.2%
Open-circuit voltage at LF socket	1 mV to 4 V peak
Resolution	1 mV
Setting error at 1 kHz	1% + 1 mV
Output impedance	approx. 10 Ω
Frequency setting time (after receiving last IEC/IEEE-bus character)	<10 ms

Analog modulation

Vector modulation

Level accuracy with vector modulation, additional error with ALC OFF, relative to CW	<0.3 dB
Mode	external DC
Modulation inputs I and Q	
Input impedance	50 Ω
VSWR (DC to 30 MHz)	<1.2
Input voltage for full-scale input	$\sqrt{I^2 + Q^2} = 0.5$ V (1 V EMF with 50 Ω source)
Static error vector [3],	
level ≤8 dBm PEP (SMIQ02B/03B)	
level ≤5 dBm PEP (SMIQ04B/06B)	
up to 3.3 GHz	
rms value	<0.5%
peak value	<1%
>3.3 GHz	
rms value	<1%
peak value	<2%
Modulation frequency response	
up to 5 MHz	<0.4 dB
up to 30 MHz	<3 dB
Carrier leakage at 0 V input voltage, referred to full-scale input [3]	<–45 dBc
I/Q impairments	
Carrier leakage	
Setting range	0% to 50%
Resolution	0.5%
I ≠ Q	
Setting range	–12% to +12%
Resolution	0.1%
Quadrature offset	
Setting range	–10° to +10°
Resolution	0.1°
Envelope control	
RF level can be controlled with an analog voltage of 0 V to 1 V via the POWER RAMP input	1 V: set level 0 V: maximum level attenuation
Input impedance	10 kΩ
Linear range	0 dB to –30 dB (typ. –35 dB)
Attenuation error at –20 dB	<0.5 dB
On/off ratio	>80 dB
Delay time	typ. 1 μs
Rise/fall time (10% to 90%)	<1 μs

Amplitude modulation[2])

Modes	internal, external AC/DC
Modulation depth	0% to 100%
Resolution	0.1%
Setting error at 1 kHz (m <80%)	<4% of reading +1%
AM distortion at 1 kHz	
m = 30%	<1%
m = 80%	<2%

Modulation frequency range	DC to 50 kHz
for RF <5 MHz	DC to 3 kHz
Modulation frequency response	
20 Hz to 20 kHz	<3 dB
for RF <5 MHz, 20 Hz to 3 kHz	<3 dB
Incidental φM at 30% AM,	
AF = 1 kHz, peak value	<0.1 rad
Modulation input EXT1	
Input impedance	>100 kΩ
Input voltage for selected modulation depth	1 V peak
High/low indication (10 Hz to 50 kHz)	for inaccuracy >3%

Broadband amplitude modulation

Mode	external DC
Modulation frequency response	
up to 10 MHz	<1 dB
up to 30 MHz	<3 dB
Modulation input (broadband AM)	
Input impedance	50 Ω
Input voltage for 100% AM	0.25 V peak

Pulse modulation

Modes	external
On/off ratio	>80 dB
Rise/fall time (10/90%)	typ. 30 ns
Pulse repetition frequency	0 kHz to 1 MHz
Pulse delay	typ. 200 ns
Modulation input AUX. IN/OUT	
Input level	TTL level (HCT)
Input impedance	10 kΩ

Frequency modulation with option SM-B5

Modes	internal, external AC/DC, two-tone with two modulation channels FM1 and FM2
Max. deviation without I/Q modulation	
0.3 MHz to 450 MHz	2 MHz
>450 MHz to 750 MHz	0.5 MHz
>750 MHz to 1500 MHz	1 MHz
>1500 MHz to 3300 MHz	2 MHz
>3300 MHz to 6400 MHz	4 MHz
Max. deviation with I/Q modulation	
0.3 MHz to 750 MHz	2 MHz
>750 MHz to 1200 MHz	1 MHz
>1200 MHz to 3300 MHz	2 MHz
>3300 MHz to 6400 MHz	4 MHz
Resolution	<1%, min. 10 Hz
Setting error at AF = 1 kHz	<3% of reading +20 Hz
FM distortion at AF = 1 kHz and half maximum deviation	<0.5%

Modulation frequency range	
with maximum deviation	DC to 500 kHz
at <25% of maximum deviation	DC to 2 MHz
Modulation frequency response	
10 Hz to 100 kHz	<0.5 dB
10 Hz to 2 MHz	<3 dB
Incidental AM at 40 kHz deviation, AF = 1 kHz, carrier frequency >5 MHz	<0.1%
Carrier frequency offset with FM	<0.01% of maximum deviation +1% of selected deviation
EXT1, EXT2 modulation inputs	
Input impedance	>100 kΩ
Input voltage for selected modulation depth	1 V peak
High/low indication (10 Hz to 100 kHz)	for inaccuracy >3%

Phase modulation with option SM-B5

Modes	internal, external AC/DC, two-tone with two modulation channels PM1 and PM2
Max. deviation without I/Q modulation	
0.3 MHz to 450 MHz	20 rad
>450 MHz to 750 MHz	5 rad
>750 MHz to 1500 MHz	10 rad
>1500 MHz to 3300 MHz	20 rad
>3300 MHz to 6400 MHz	40 rad
Max. deviation with I/Q modulation	
0.3 MHz to 750 MHz	20 rad
>750 MHz to 1200 MHz	10 rad
>1200 MHz to 3300 MHz	20 rad
>3300 MHz to 6400 MHz	40 rad
Resolution	<1%, min. 0.001 rad
Setting error at AF = 1 kHz	<3% of reading + 0.01 rad
Distortion at AF = 1 kHz and half maximum deviation	<1%
Modulation frequency range	DC to 100 kHz
Modulation frequency response	
10 Hz to 100 kHz	<0.5 dB
EXT1, EXT2 modulation inputs	
Input impedance	>100 kΩ
Input voltage for selected Modulation depth	1 V peak
High/low indication (10 Hz to 100 kHz)	for inaccuracy >3%

Digital modulation with Option Modulation Coder SMIQB20

Modes	internal, external serial, external parallel
Predefined modulation settings	APCO C4FM, APCO CQPSK, CDPD, CT2, DECT, GSM, IRIDIUM, NADC, PDC, PHS, TETRA, TFTS, PWT, ICO BPSK, ICO GMSK, ICO QPSK, GSM EDGE, CDMA IS-95, W-CDMA, QPSK
Internal PRBS	selectable lengths: 2^9-1, $2^{15}-1$, $2^{16}-1$, $2^{20}-1$, $2^{21}-1$ and $2^{23}-1$
I/Q bandwidth	12 MHz
Modulation specifications apply at levels ≤8 dBm with SMIQ02B/03B and at levels ≤5 dBm with SMIQ04B/06B	
Inputs	DATA, BIT CLOCK, SYMBOL CLOCK, PAR DATA
Serial data are taken from BNC connectors, parallel data (symbols) from rear PAR DATA connector. Parallel symbols may contain 1 to 8 bits and read in using an internal or external clock signal	
Trigger threshold	–2.5 V to +2.5 V, selectable, resolution 0.1 V
Input impedance	1 kΩ to ground, 50 Ω to ground
Max. data rate	
serial	30 Mbit/s, typ. 50 Mbit/s
parallel	18 Msymbol/s
Outputs	DATA, BIT CLOCK, SYMBOL CLOCK, PAR DATA, (all TTL levels)
I and Q baseband signals, output voltage, EMF, peak value	$\sqrt{I^2 + Q^2} = 1\ \mathrm{V}$
Power Ramp	
Output voltage	0 V to 1 V
Output impedance	10 Ω
Level attenuation	
via LEV ATT input	
Range	0 dB to 70 dB
Additional level error caused by attenuation 3)	<1 dB (up to 35 dB), <1.5 dB (up to 70 dB)
Envelope control	
Modes	
Analog	external via POWER RAMP input (for data see vector modulation above). With an internal power ramp, the connector serves as an output.
Digital	internal or external via BURST GATE input/output (PAR DATA connector). The BURST GATE input triggers a power ramp (TTL levels). The low/high transition starts the ramp function from blanking level to maximum level, the high/low transition from maximum level to blanking level. With an internal power ramp, the connector serves as an output.
Function range	1 ksymbol/s to 2.5 Msymbol/s
Rise/fall time	
Setting range	0.25 symbols to 32 symbols
Resolution	1/4 symbol
Minimum time	1 µs
Modulation Modes	ASK, FSK, GMSK, PSK, QAM
Baseband filter Each filter can be used with any type of modulation. Exception: GMSK/GFSK only with baseband filter Gauss	√cos (α = 0.1 to 0.99), cos (α = 0.1 to 0.99), resolution 0.01 Gauss, BxT = 0.15 to 2.5, resolution 0.01 GaussLin, BxT = 0.3 Bessel, BxT = 1.25 and 2.5 IS-95 with or without equalizer special filter for W-CDMA, APCO C4FM special filter for TETRA split phase, B x T = 0.15 to 2.5 rectangular

Filter modes	low EVM: for minimum error vector low ACP: for minimum adjacent-channel power
ASK	
Symbol rate	100 symbol/s to 18 Msymbol/s 13)
Modulation depth	0% to 100%
FSK	
Modulation modes	2FSK, 4FSK, 4FSK APCO, GFSK
Symbol rate	100 symbol/s to 7.5 Msymbol/s 13)
Shift	0.1 to 100 x f_{symb}
Resolution	<0.5%
Deviation error, rms value for shift 200 Hz to 650 kHz, symbol rate <1.3 Msymbol/s, filter √cos or cos with α = 0.25 to 0.7 or Gauss with BxT = 0.2 to 0.7	<1.3%
GMSK	
Bit rate	100 bit/s to 7.5 Mbit/s 13)
Modulation phase error with PRBS data,	
up to 1 Mbit/s, rms value	<1°
Peak value	<3°
PSK	
Modulation modes	BPSK, QPSK, OQPSK, QPSK (IS-95), OQPSK (IS-95), QPSK (ICO), QPSK (INMARSAT), π/4DQPSK, π/4QPSK, 8PSK, 8PSK EDGE
Symbol rate	100 symbol/s to 18 Msymbol/s 13)
Error vector magnitude, rms for filter √cos, cos, IS-95, W-CDMA	
up to 200 ksymbol/s, α ≥0.25	<1.2%
up to 1.5 Msymbol/s, α ≥0.25	<2%
up to 3 Msymbol/s, α ≥0.25	<3%
>3 Msymbol/s, α ≥0.25	typ. <3%
QAM	
Modulation modes	16QAM, 32QAM, 64QAM, 256QAM
Symbol rate	100 symbol/s to 18 Msymbol/s 13)
Error vector magnitude, rms with16QAM for filter √cos, cos, IS-95, W-CDMA	<2%
up to 1 Msymbol/s, α ≥0.25	<3%
up to 3 Msymbol/s, α ≥0.25	typ. <3%
>3 Msymbol/s, α ≥0.25	
USER MAPPING	VIA IEEE-Bus
Modulation modes	PSK, QAM, FSK
Modulation symbols	
Number of symbols	2^1 to 2^8, up to 8 bit per symbol
Programming	via remote control, IEC/IEEE-bus
Range of symbol rate	
with PSK, QAM	100 symbol/s to 18 Msymbol/s 13)
with FSK	100 symbol/s to 7.5 Msymbol/s 13)
Baseband filter	
with PSK, QAM	√cos, cos, GaussLin, IS-95, TETRA, W-CDMA, rectangular
with FSK	Gauss, GaussLin, Bessel, APCO, W-CDMA, rectangular
Modulation coding	differential coding, differential and Gray, GSM, NADC, TETRA, TFTS, PDC, PHS, differential phase coding, APCO25, PWT, INMARSAT, VDL

Modulation with coding

The table below shows the possible combinations of modulation with coding (X = combination possible).

	Coding off	Differential	Differential phase	Differential + Gray	GSM	NADC, PDC, PHS, TETRA, APCO25, PWT	TFTS/ TETRA	INMARSAT	VDL
ASK	X	X		X					
BPSK	X	X		X					
QPSK	X	X		X				X	
QPSK (IS-95)	X	X		X				X	
INMARSAT	X	X		X				X	
QPSK ICO	X	X		X				X	
OQPSK	X	X		X				X	
OQPSK (IS-95)	X	X		X				X	
$\pi/4$ QPSK	X								
$\pi/4$ DQPSK	X					X	X		
8PSK	X	X		X					X
8PSK_EDGE	X	X		X					X
2FSK	X	X		X	X				
4FSK, 4FSK APCO	X	X		X					
GFSK	X	X		X	X				
GMSK	X	X		X	X				
16QAM	X	X	X	X					
32QAM	X	X	X	X					
64QAM	X	X	X	X					
256QAM	X		X						

Data generator (option SMIQB11)

Programmable data memory for modulation data, envelope-control and trigger signals. The data generator can be operated only in conjunction with the optional modulation coder.

Memory capacity	15 Mbit
Max. symbol rate	8.5 Msymbol/s
Modes	automatically repeating, single shot, manually or externally triggered
Inputs	
Trigger input TRIGIN	for starting the data sequences in the data memory
Trigger frequency	<10 kHz
Selectable trigger delay	0 to $2^{16}-1$ symbols
Selectable trigger suppression	0 to $2^{26}-1$ symbols after trigger
Switching threshold	–2.5 V to 2.5 V, selectable, resolution 0.1 V
Input impedance	1 kΩ to ground, 50 Ω to ground
Required pulse width	>50 ns
Outputs	
DATA modulation data	see data under "Digital Modulation"
BURST GATE, LEV ATT	control signals for envelope control and level attenuation
CW	control signal for switching off digital modulation

TRIGOUT 1, TRIGOUT 2	user-programmable trigger signals
TRIGOUT 3	trigger signal on event
HOP	control signal for frequency hopping in LIST MODE

Memory extension (option SMIQB12)

The data generator memory can be extended to max. 79 Mbit by fitting up to two options SMIQB12.

Memory capacity	32 Mbit

Digital standards with options SMIQB20 and SMIQB11

Modulation and ACP specifications apply at the respective standard frequency ranges and at levels
≤8 dBm PEP with SMIQ02B/03B
≤5 dBm PEP with SMIQ04B/06B

Data sources	
with TDMA	internal, external via RS232 interface (SERDATA)
with CDMA	internal
Digital standard GSM / EDGE	**to GSM standard**
Frequency	
Standard	880 MHz to 960 MHz/1710 MHz to 2000 MHz
Range	same as SMIQ
Modulation	GMSK or 8PSK EDGE (8PSK with $3\pi/8$ rotation)
Symbol rate	
Standard	270 833 symbol/s
Range	100 to 300 000 symbol/s
Baseband filter (GMSK)	
Standard	Gauss, BxT = 0.3
Range	Gauss, BxT = 0.2 to 0.7
Baseband filter (8PSK EDGE)	Gauss Linear
Frame structure	1 to 8 slots user-definable any burst types can be combined, incl. GSM and EDGE mixed
Burst types	NORMAL, DUMMY, ALL DATA, NORMAL EDGE
Burst on/off ratio	>80 dB
Burst rise/fall time	corresponding to 3 symbols, <18 μs
Slot attenuation, selectable	0 dB to 70 dB
Internal modulation data	PRBS, 2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{16}-1$, $2^{20}-1$, $2^{21}-1$, $2^{23}-1$, programmable data memory
External serial modulation data	asynchronous via RS232 interface (SERDATA)
Phase error, rms value	<1°, typ. 0.3°
Phase error, peak value	<3°, typ. 1°
Power density spectrum, typ. values (standard, resolution bandwidth 30 kHz, without power ramping)	
Offset 200 kHz	–34 dB
Offset 400 kHz	–70 dB
Offset 600 kHz	–78 dB
Digital standard DECT	**to ETS300175-2 and ETS300176-1**
Frequency	
Standard	1880 MHz to 1900 MHz
Range	same as SMIQ

Modulation	GFSK (standard), $\pi/4$ DQPSK
Deviation with GFSK	
Standard	288 kHz
Range	0.1 to 1 x f_{symb}
Symbol rate	
Standard	1152000 symbol/s
Range with GFSK	200 symbol/s to 1200000 symbol/s
Range with $\pi/4$ DQPSK	100 symbol/s to 600000 symbol/s
Baseband filter	
Standard	Gauss, B x T = 0.5
Range	Gauss, B x T = 0.2 to 0.7 $\sqrt{\cos}$ (α = 0.2 to 0.7), cos (α = 0.2 to 0.7)
Frame structure	1 to 12 slots of 24 slots user-definable
Slot types	FULL (basic), DOUBLE (high capacity), ALL DATA
Burst on/off ratio	>80 dB
Burst rise/fall time	corresponding to 2 symbols, <10 µs
Slot attenuation, selectable	0 dB to 70 dB
Internal modulation data	PRBS, 2^9-1, $2^{15}-1$, $2^{16}-1$, $2^{20}-1$, $2^{21}-1$, $2^{23}-1$, programmable data memory
Deviation error, rms	<1.3%
Special functions	
Timing adjustment simulation	lengthening (+) or shortening (–) of every 35th frame
Range	–4 bit to +4 bit (resolution 1 bit)
Jitter simulation	time lead for even-numbered frames
Range	0 bit to +4 bit (resolution 1 bit)
Slot timing shift	time shifting of a single slot
Range	–9 bit to +9 bit (resolution 1 bit)
Selectable preamble	normal or prolonged
Response during ramp-up	modulated or CW
Digital standard NADC	**to IS-54 and IS-136**
Frequency	
Standard	824 MHz to 894 MHz/1850 MHz to 2000 MHz
Range	same as SMIQ
Modulation	$\pi/4$ DQPSK
Symbol rate	
Standard	24300 symbol/s
Range	100 symbol/s to 200000 symbol/s
Baseband filter	
Standard	$\sqrt{\cos}$ (α=0.35), cos (α=0.35)
Range	$\sqrt{\cos}$ (α=0.2 to 0.7), cos (α=0.2 to 0.7)
Frame structure	1 to 6 slots user-definable for uplink and downlink
Burst types	Up/Down TCH, ALL DATA, Up SHORT
Burst on/off ratio	>80 dB
Burst rise/fall time	corresponding to 3 symbols, <123.4 µs
Slot attenuation, selectable	0 dB to 70 dB
Internal modulation data	PRBS, 2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{16}-1$, $2^{20}-1$, $2^{21}-1$, $2^{23}-1$, programmable data memory
External serial modulation data	asynchronous via RS232 interface (SERDATA)
Error vector magnitude, rms	<1.2%, typ. 0.4%
Adjacent-channel power, typ. values, without power ramping	
Offset 30 kHz	–35 dBc
Offset 60 kHz	–75 dBc
Offset 90 kHz	–78 dBc

Digital standard PDC	**to RCR STD-27**
Frequency	
Standard	810 MHz to 826 MHz/940 MHz to 956MHz /1429 MHz to 1453 MHz/1477 MHz to 1501 MHz
Range	same as SMIQ
Modulation	π/4 DQPSK
Symbol rate	
Standard	21000 symbol/s
Range	100 symbol/s to 200000 symbol/s
Baseband filter	
Standard	√cos (α=0.5), cos (α=0.5)
Range	√cos (α=0.2 to 0.7), cos (α=0.2 to 0.7)
Frame structure	1 to 6 slots user-definable for uplink and downlink
Burst types	TCH, SYNC, VOX, ALL DATA
Burst on/off ratio	>80 dB
Burst rise/fall time	corresponding to 2 symbols, <95.2 μs
Slot attenuation, selectable	0 dB to 70 dB
Internal modulation data	PRBS, 2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{16}-1$, $2^{20}-1$, $2^{21}-1$, $2^{23}-1$, programmable data memory
External serial modulation data	asynchronous via RS232 interface (SERDATA)
Error vector magnitude, rms	<1.2%, typ. 0.4%
Adjacent-channel power, typ. values, without power ramping	
Offset 50 kHz	–74 dBc
Offset 100 kHz	–78 dBc
Digital standard PHS	to RCR STD-28
Frequency	
Standard	1895.0 MHz to 1918.1 MHz
Range	same as SMIQ
Modulation	π/4 DQPSK
Symbol rate	
Standard	192000 symbol/s
Range	100 symbol/s to 200000 symbol/s
Baseband filter	
Standard	√cos (α=0.5), cos (α=0.5)
Range	√cos (α = 0.2 to 0.7), cos (α = 0.2 to 0.7)
Frame structure	1 to 8 slots user-definable
Burst types	TCH (32 kbit and 16 kbit channel), SYNC, VOX, ALL DATA
Burst on/off ratio	>80 dB
Burst rise/fall time	corresponding to 2 symbols, <13 μs
Slot attenuation, selectable	0 dB to 70 dB
Internal modulation data	PRBS, 2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{16}-1$, $2^{20}-1$, $2^{21}-1$, $2^{23}-1$, programmable data memory
External serial modulation data	asynchronous via RS232 interface (SERDATA)
Error vector magnitude, rms	<1.2%, typ. 0.4%
Adjacent-channel power, typ. values, without power ramping)	
Offset 600 kHz	–74 dBc
Offset 900 kHz	–76 dBc

Digital standard IS-95 CDMA with option SMIQB42

Modulation and ACP specifications apply at the respective standard frequency ranges and at levels
≤8 dBm PEP with SMIQ02B/03B
≤5 dBm PEP with SMIQ04B/06B

To TIA standard IS-95A and J-STD-008	
Frequency	
Standard	824 MHz to 894 MHz, 1850 MHz to 2000 MHz
Range	same as SMIQ
Modulation	QPSK, OQPSK
Chip rate	
Standard	1.2288 Mcps
Range	0.1 Mcps to 7 Mcps
Reverse link coded	0.1 Mcps to 1.3 Mcps
Sequence length	
Forward link	1 superframe (80 ms)
Reverse link	1 superframe (80 ms) if user-definable data lists are used: calculation in real time, ie unlimited sequence length
Reserve link coded	calculation in real time, ie unlimited sequence length
Baseband filter	IS-95 with or without equalizer
Standard	$\sqrt{}$cos (α=0.2 to 0.7),
Other filters	cos (α=0.2 to 0.7)
Forward link, mode 18	
Number of code channels	1 to 18
Walsh code selectable	0 to 63
Code channel power	0.0 dB to –30 dB, 4 user-definable levels
Forward link, mode 64	
Number of code channels	1 to 64
Code channel power	0.0 dB to –30 dB, 2 user-definable levels
Reverse link	full-rate mode, half-rate mode with random power gating
Reverse link coded	incl. frame quality indicator, convolutional encoder, block interleaver traffic channel, 9600/4800/2400/1200 bps traffic channel, 14400/7200/3600/1800 bps access channel, 4800 bps
Internal modulation data	
Forward link, 19200 bit/s	PRBS, 0 sequence, 1 sequence, 01 alternating, different for each code channel
Reverse link, 28800 bit/s	PRBS, 0 sequence, 1 sequence, 01 alternating, programmable data memory
Reverse link coded	PRBS, 2^9–1, 2^{15}–1, 2^{16}–1, 2^{20}–1, 2^{21}–1, 2^{23}–1, programmable data memory
Synchronization signals (chip rate 1.2288 Mcps)	chip clock, input and output, 2 outputs for 80 ms, 80/3 ms, 20 ms, 2 s clock, trigger input
Modulation accuracy ρ	>0.9996

Adjacent-channel power in 30 kHz bandwidth, typ. values	
reverse link	
offset 885 kHz	typ. –77 dBc
offset 1.25 MHz	typ. –83 dBc
offset 1.98 MHz	typ. –84 dBc
with option SMIQB47, IQ filter 850 kHz	
offset 885 kHz	<–78 dBc, typ. –82 dBc
offset 1.25 MHz	<–83 dBc, typ. –87 dBc
offset 1.98 MHz	<–85 dBc, typ. –89 dBc
9 channels forward link	
offset 885 kHz	typ. –77 dBc
offset 1.25 MHz	typ. –79 dBc
offset 1.98 MHz	typ. –80 dBc
with option SMIQB47, IQ filter 850 kHz	
offset 885 kHz	<–74 dBc, typ. –78 dBc
offset 1.25 MHz	<–80 dBc, typ. –84 dBc
offset 1.98 MHz	<–83 dBc, typ. –86 dBc

Digital standard W-CDMA with option SMIQB43 [11]

According to NTT DoCoMo 1.0 and ARIB standard 0.0
Modulation and ACP specifications apply at the respective standard frequency ranges and at levels
≤8 dBm PEP with SMIQ02B/03B
≤5 dBm PEP with SMIQ04B/06B

Frequency	
Standard	1800 to 2200 MHz
Range	same as SMIQ
Modulation	QPSK, OQPSK
General settings	
Chip rate	
Standard	4.096 Mcps
Range	0.1 Mcps to 7 Mcps
Link direction	uplink and downlink
Sequence length	45 frames without option SMIQB12 150 frames with 1 option SMIQB12 240 frames with 2 options SMIQB12
Baseband filter	
Standard	W-CDMA 0.22
Other filters	√cos (α = 0.1 to 0.7), cos (α = 0.1 to 0.7)
Code channels and spreading	
Number	mode 4: 4 channels with different power mode 8: 8 channels, 1 channel with different power and 7 channels with equal power mode 15: 15 channels with equal power
Multicode operation	yes
Code channel power	0.0 dB to –30 dB
Short code	selectable for each code channel
Range	0 to 127
LMS	1 to FF hex
Long code	selectable for each code channel
Initial value uplink	0 to 1FFFFFFFFFF hex
Initial value downlink	0 to 3FFFF hex
Time offset	0 to 40959 chips (1 radio frame)

Physical channel with frame structure	downlink, uplink, uplink IQ-multiplexed to ARIB standard
Link direction	0.0
Downlink channels	perch 1, common control 64 ksymb/s, dedicated channel with 32, 64, 128, 256, 512, 1024 ksymb/s
Uplink channels	common control 64 ksymb/s, dedicated channel with 32, 64, 128, 256, 512, 1024 ksymb/s
Uplink channels (ARIB)	dedicated control channel with 16 ksymb/s, dedicated data channel with 16, 32, 64, 128, 256, 512, 1024 ksymb/s
Data offset	time offset, separately adjustable for each code channel
Range offset	0 to 1 radio frame
Resolution offset	1 symbol
Internal modulation data	
DATA field	PRBS, 2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{16}-1$ programmable data memory
TPC field	00, 11, alternating, programmable data memory
Synchronization signals:	chip clock, input and output outputs for slot, frame clock or marker for repetition of chip sequence trigger input
Error vector magnitude, rms	<2%, typ. 1.5%
with option SMIQB47, IQ-filter 2.5 MHz	<3%, typ. 1.8%
Adjacent-channel power, 1 DTCH	
offset 5 MHz	typ. –64 dBc 8)
offset 10 MHz	typ. –67 dBc 8)
with option SMIQB47, IQ filter 2.5 MHz	
offset 5 MHz	<–64 dBc, typ. –67 dBc 8)
offset 10 MHz	<–67 dBc, typ. –71 dBc 8)

Digital standard W-CDMA 3GPP (FDD) with option SMIQB45 12)

According to 3GPP Standard 2.0.0/2.1.0 (FDD)
Modulation and ACP specifications apply at the respective standard frequency ranges and at levels
≤8 dBm PEP with SMIQ02B/03B
≤5 dBm PEP with SMIQ04B/06B

3GPP (FDD) Version	optionally 2.0.0 or 2.1.0, in line with 3GPP Technical Specification TS25.211 and TS25.213 (both versions with HPSK in uplink)
Frequency	
Standard	1800 MHz to 2200 MHz
Range	same as SMIQ
General Settings	
Chip rate	
Standard	3.840 Mcps (15 Slots/Frame), in this case the symbol rates of all code channels reduce by 1/16 4.096 Mcps, 8.192 Mcps, 16.384 Mcps (16 Slots/Frame)
Range	0.1 Mcps to 18 Mcps
Link direction	uplink (reverse link) und downlink (forward link)
Sequence length	entered in frames, max. length depending on chip rate 1 to 13 frames for 3.840 Mcps 1 to 12 frames for 4.096 Mcps 1 to 6 frames for 8.192 Mcps 1 to 3 frames for 16.384 Mcps

Basisband filter	
Standard	√cos, α = 0.22
Further filters	cos (α = 0,1 ... 0,7), cos (α = 0,1 ... 0,7)
Code channels	up to 512 data channels (plus special channels) distributed to max. 4 base or mobile stations (BS/MS) with 128 code channels each
Physical channels in downlink	
PERCH	consisting of PCCPCH, PSCH and SSCH
Symbol rate	16 ksymbols/s, fixed
Spreading code	0, fixed
Power offset primary SCH	–10 dB to +10 dB
Power offset secondary SCH	–10 dB to +10 dB
Slot structure	PCCPCH: data, pilot PSCH and SSCH: synchronization code (SC)
SCCPCH	Secondary Common Control Physical Channel
Symbol rate	8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 ksymbol/s
Spreading code	value range 0 to max. 2047, depending on chip rate and symbol rate
Slot structure	TFCI, data, pilot
DPCH	Dedicated Physical Channel
Symbol rate	8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 ksymbol/s
Spreading code	value range 0 to max. 2047, depending on chip rate and symbol rate
Slot structure	TFCI, TPC, data, pilot
Physical channels in uplink	
PRACH	Physical Random Access Channel
Symbol rate	16, 32, 64, 128 ksymbol/s
Spreading code	value range 0 to max. 1023, depending on chip rate and symbol rate
Access slot	1 to 8
Signature	0 to 16
Slot structure	preamble and message part message part I: data message part Q: pilot, TFCI, ..., pilot, TFCI
DPCCH	Dedicated Physical Control Channel
Symbol rate	16 ksymbol/s, fixed
Spreading code	0, fixed
Slot structure	pilot, TFCI, FBI, TPC
DPDCH	Dedicated Physical Data Channel
Symbol rate	16, 32, 64, 128, 256, 512, 1024, 2048, 4096 ksymbol/s
Spreading code	value range 0 to max. 1023, depending on chip rate and symbol rate
Slot structure	data
Parameter for each BS	
State	OFF/ON
2nd search code group	1 to 34
Power offset primary SCH	–10 dB to +10 dB
Power offset secondary SCH	–10 dB to +10 dB
TFCI state	OFF/ON
TFCI	0 to 63
Long code init	0 to 3 FFFF hex

T sector	time offset of total signal of BS
Range	0 to 163.839 depending on chip rate (up to 1 radio frame)
Resolution	1 chip
Use TPC for dynamic output Power control	OFF/ON with this function activated, the TPC pattern is used to vary the transmit power of the code channels over time
Output power control step	–10 dB to +10 dB
Transmit diversity	OFF/antenna 1/antenna 2 with this function activated, the output signal for antenna 1 or 2 can be generated as defined in the standard
Parameter for each MS	
State	OFF/ON
Long code init	0 to 1FF FFFF FFFF hex
Access slot (PRACH)	1 to 8
Signature (PRACH)	0 to 16
T sector	time offset of total signal of MS
Range	0 to 163.839 depending on chip rate (up to 1 radio frame)
Resolution	1 chip
TFCI state	OFF/ON
TFCI	0 to 63
FBI state	OFF/1bit/2bit
FBI pattern	all 0, all 1 and bit pattern (max. length 16 bit)
TPC pattern	all 0, all 1 and bit pattern (max. length 16 bit)
Use TPC for dynamic output Power control	OFF/ON with this function activated, the TPC pattern is used to vary the transmit power of the code channels over time
Output power control step	–10 dB to +10 dB
Parameters for each code channel, independently selectable	
State	OFF/ON
Symbol rate	between 8 ksymbol/s and 4096 ksymbol/s, depending on type of physical channel
Spreading code	value range 0 to max. 2047, depending on chip rate and symbol rate
Power	–60 to 0 dB
User data	PRBS: PN9, PN11, PN15, PN16 all 0, all 1 and bit pattern (max. length 16 bit)
Data offset	time offset, separately adjustable for each code channel
Range	0 to 40959 (up to 1 radio frame)
Resolution	1 symbol
TPC pattern (downlink only)	all 0, all 1 and bit pattern (max. length 16 bit)
Multicode state (downlink only)	OFF/ON

Assistant functions to facilitate operation	
Parameterizable predefined settings	generation of complex signal scenarios with parameterizable predefined settings; selectable parameters: • use and symbol rate of special channels (PERCH, SCCPCH in downlink and PRACH, DPCCH in uplink) • number and symbol rate of data channels • crest factor: minimal/average/worst
Multichannel edit	common configuration of data channels of BS or MS channel table; selectable parameters, partly with start value and step size: • range of data channels to be set • symbol rate • spreading code with step size • channel power with step size • data • TPC (downlink only) • data offset with step size • multicode state (downlink only) • state
Copy BS/MS	copying the configuration of a BS/MS for another BS/MS for the definition of multi-BS/MS scenarios or BS/MS with more than 128 channels; parameters: • source and target of copying • spreading code offset for simple definition of BS/MS signals with more than 128 channels and continuous spreading codes
Resolve domain conflicts	elimination of code channel overlapping in code domain occurred in a BS/MS (domain conflicts)
Graphical displays	
Domain conflicts	display of domain conflicts (overlapping of individual code channels in code domain) in the channel table lines concerned; occupied code domain of code channels involved in the conflict can be displayed on request
Code domain	graphical display of code domain occupied by the current BS/MS; domain sectors in which conflicts occur are highlighted; code channel distribution in the code domain and channel powers are displayed qualitatively
Channel graph	display of all active channels of a BS/MS via the channel table index; the power of the individual code channels is shown qualitatively
CCDF	display of complementary cumulative distribution function of current signal; this function gives the probability of the magnitude of complex IQ samples exceeding a predefined threshold; together with the current CCDF, the CCDF of the two 3GPP signals generated last can be displayed to observe the effect of parameter changes; the crest factor of the signal can be seen in the CCDF
Constellation diagram	display of constellation diagram of the unfiltered IQ samples of the current 3GPP signal; this diagram allows qualitative assessment of channel configuration, channel power ratios and effect of parameters such as data and data offset

SMIQB45	
Adjacent-channel power	
(standard, 1DPCH)	
Chip rate 4.096 Mcps	
offset 5 MHz	typ. –64 dBc [10]
offset 10 MHz	typ. –66 dBc [10]
with option SMIQB47, IQ filter 2.5 MHz	
offset 5 MHz	–64 dBc, typ. –67 dBc [10]
offset 10 MHz	–67 dBc, typ. –71 dBc [10]

Simultaneous modulation

Any combination possible with the following exceptions:
FM and φM at the same time
Digital modulation and vector modulation at the same time
Pulse modulation cannot be used together with level attenuation function LEV ATT (option SMIQB20)

Overview of digital TDMA standards

The table below summarizes the key data for the digital TDMA standards implemented in SMIQ. Options SMIQB20 and SMIQB11 are required for all standards.

	GSM (GMSK)	GSM (8PSK)	DECT	NADC	PDC	PHS
Error vector magnitude, rms	N/A	<1.2 %, typ. 0.6 %	N/A	<1.2 %, typ. 0.4 %	<1.2 %, typ. 0.4 %	<1.2 %, typ. 0.4 %
Phase error (standard), rms	<1°, typ. 0.3°	N/A	N/A	N/A	N/A	N/A
peak value	<3°, typ. 1°					
Deviation error, rms	N/A	N/A	<1.3 %	N/A	N/A	N/A
Channel spacing/kHz	200	200	1728	30	25	300
Power density spectrum, typ. resolution BW 30 kHz Offset 200 kHz 400 kHz 600 kHz	 –34 dB –70 dB –78 dB	 –34 dB –70 dB –78 dB	N/A	N/A	N/A	N/A
Adjacent-channel power (ACP), typ. at adjacent channel at 1st alternate channel at 2nd alternate channel at 3rd alternate channel	N/A	N/A	N/A	 –35 dBc –75 dBc –78 dBc –	 – –74 dBc – –78 dBc	 – –74 dBc –76 dBc –
Burst types	NORMAL, DUMMY, ALL DATA	NORMAL EDGE	FULL (basic), DOUBLE (high capacity), ALL DATA	up/down TCH, ALL DATA, Up SHORT	TCH, SYNC, VOX, ALL DATA	TCH (32 kbit and 16 kbit), SYNC, VOX, ALL DATA

Fading simulation with options SMIQB14, SMIQB15

RF bandwidth (–3 dB)	>14 MHz
Additional frequency response	
up to 5 MHz offset from carrier	<0.4 dB, typ. <0.2 dB
Carrier leakage	typ. –45 dBc
Setting time after RF frequency change	<3 ms
Modes	external via I and Q modulation inputs, internal with option SMIQB10
Number of paths and channels	
with option SMIQB14	6 paths, 1 channel
with options SMIQB14 and -B15	12 paths, 1 channel, or 6 + 6 paths, 2 channels with second SMIQ through simple retrofit (for instructions see manual)
Path attenuation	
Range	0 dB to 50 dB
Resolution	0.1 dB
Error (in the range 0 to 20 dB)	<0.3 dB
Path delay	
Range	0 µs to 1600 µs
Resolution	50 ns
Error	<5 ns
Doppler shift	
Frequency range	0.1 Hz to 1600 Hz
Speed range	$v_{min} = \frac{0,03x10^9\frac{m}{s^2}}{f_{RF}}$ $v_{max} = \frac{479x10^9\frac{m}{s^2}}{f_{RF}}$
example with f_{RF} =1 GHz: v_{min}= 0.1 km/h, v_{max}=1724 km/h	
Resolution	0.1 km/h, m/s, mph
Error	<0.13%
Rayleigh fading	
Pseudo noise interval	>372 h
Deviation from theoretical CPDF 4) for P_{avg} = 0 dB	
path attenuation from –20 dB to + 10 dB	<1 dB, typ. <0.3 dB
path attenuation from –30 dB to –20 dB	<2 dB, typ. <0.3 dB
Rice fading	
Power ratio 5)	
Range	–30 dB to +30 dB
Resolution	0.1 dB
Frequency ratio	
Range	–1 to +1
Resolution	0.05
Log Normal fading, Suzuki fading	
Standard deviation	
Range	0 dB to 12 dB
Resolution	1 dB
Local constant	l_{min} to 200 m $l_{min} = \frac{12x10^9\frac{m}{s}}{f_{RF}}$
Correlation	paths 1 to 6 with paths 7 to 12
Magnitude range	0% to 100%
Resolution	5%
Phase range	0° to 360°
Resolution	1°
General data; thermal loading	specs guaranteed in range 0 °C to 45°C

Noise and distortion simulation with option SMIQB17

RF bandwidth (–3 dB)	>14 MHz
Additional frequency response up to 5 MHz offset from carrier	<0.8 dB
Carrier leakage [9]	typ. –40 dBc
Distortion simulator	
Type of distortion	AM/AM and AM/PM distortion of modulation signal
Distortion characteristic	each characteristic programmable by entering up to 30 input values via IEC/IEEE bus or by entering up to five polynomial coefficients
Resolution	12 bit
Noise generator (AWGN)	
Distribution density	Gaussian, statistically independent for I and Q
Crest factor	14 dB
C/N	
Range	–30 dB to 30 dB
Resolution	0.1 dB
Error for system bandwidth = symbol rate and C/N <20 dB [3]	
Vector, PSK, QAM modulation	<0.4 dB
FSK, GMSK modulation [10]	<0.4 dB
System bandwidth	relevant bandwidth for determining noise power N
Range	10 kHz to 10 MHz
Resolution	1×10^{-2}
Output spectrum	white noise
Frequency response up to 0.7 x system bandwidth and 5 MHz offset from carrier at RF output [3]	<0.8 dB

Bit error rate measurement with option SMIQB21

The data supplied by the DUT are compared with a reference random bit squence.

Pseudo-random bit sequences (PRBS)	2^9-1, 2^{11}-1, 2^{15}-1, 2^{16}-1, 2^{20}-1, 2^{21}-1, 2^{23}-1
Clock source	supplied by DUT; a clock pulse is required for each valid bit
Clock rate	max. 30 MHz
Synchronization time	24 clocks
Interface	9-pin sub-D connector, sub-D/BNC cable supplied with option
Data	TTL
Data enable	TTL
Clock	TTL
Restart	TTL
Setup time	10 ns
Hold time	2 ns
Polarity	normal and inverted (data, clock, data enable)
Measurement time	selectable through maximum number of data bits or bit errors (max. 2^{31} bits each), continuous measurement
Measurement result	BER in ppm (if selected number of data bits or bit errors is attained); status displays: not synchronized, no clock, no data

Option SMIQB47 for improved adjacent-channel power for W-CDMA and CDMA IS-95

Modulation and ACP specifications apply at the respective standard frequency ranges and at levels
≤8 dBm PEP with SMIQ02B/03B
≤5 dBm PEP with SMIQ04B/06B

Selectable baseband filters to improve ACP values (values see at Digital Standards CDMA/W-CDMA)	
Bandwith	OFF, 850 kHz, 2.5 MHz, 5 MHz
W-CDMA 4.096 Mchip, 1DTCH, f = 1800 MHz to 2200 MHz, IQ filter 2.5 MHz	
offset 5 MHz	<–64 dBc, typ. –67 dBc 8)
offset 10 MHz	<–67 dBc, typ. –71 dBc 8)
IS-95 CDMA, f = 824 MHz to 894 MHz and 1850 MHz to 2000 MHz, IQ filter 850 kHz	
Reverse link	
offset 885 kHz	<–78 dBc, typ. –82 dBc
offset 1.25 MHz	<–83 dBc, typ. –87 dBc
offset 1.98 MHz	<–85 dBc, typ. –89 dBc
9 channels forward link	
offset 885 kHz	<–74 dBc, typ. –88 dBc
offset 1.25 MHz	<–80 dBc, typ. –84 dBc
offset 1.98 MHz	<–83 dBc, typ. –86 dBc
Error vector magnitude, rms	
W-CDMA 4.096 Mchip, IQ filter 2.5 MHz	<3%, typ. 1.8%
IS-95 CDMA IQ filter 850 kHz	<2%, typ. 1.3%

Certified Quality System
ISO 9001
DQS REG.NO 1954-04

Other data

Memory for instrument settings

50 storable settings

Memory sequence modes	automatic, single shot, manual or external trigger
Step time	50 ms to 60 s
Resolution	1 ms

List mode

Frequency and level values can be stored in a list and set in an extremely short time; permissible level variation: 90 dB

Modes	automatic, single shot, manual or external trigger
Max. number of channels	2000
Step time	1 ms to 1 s
Resolution	0.1 ms

Remote control

System	IEC 625 (IEEE 488)
Command set	SCPI 1993.0
Connector	24-contact Amphenol
IEC/IEEE-bus address	0 to 30
Interface functions	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0
System	RS 232
Command set	SCPI 1993.0
Connector	9-contact D-SUB
Baud rate	1.2 kbit/s to 115.2 kbit/s

General data

Power supply	90 V to 265 V (AC), 50 Hz to 400 Hz, autosetting to AC supply, max. 300 VA
Electromagnetic compatibility	to EN 50081-1 and EN 50082-2 (EC EMC directive)
RF leakage at carrier frequency <1 GHz	<0.1 µV (induced in a two-turn coil 25 mm dia. at a distance of 25 mm from any surface of the enclosure)
Immunity to RFI	10 V/m
Ambient conditions	
Operating temperature range	0°C to 50°C [6] to IEC68-2-1 and IEC68-2-2
Storage temperature range	–40°C to +70°C
Climatic conditions	95% relative humidity at +25°C/+40°C cyclically, to IEC68-2-30
Mechanical resistance	
Sinewave vibrations	5 Hz to 150 Hz, max. 2 g at 55 Hz, max. 0.5 g in range 55 Hz to 150 Hz, to IEC68-2-6, IEC1010-1 and MIL-T-28800D, class 5
Random	10 Hz to 300 Hz, acceleration 1.2 g (rms)
Shock	40 g shock spectrum, to MIL-STD-810D, MIL-T-28800D, class 3 and 5
Safety	to EN 61010-1
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	25 kg when fully equipped

Ordering information

Vector Signal Generator		
SMIQ02B (0.3 to 2.2 GHz)		1125.5555.02
SMIQ03B (0.3 to 3.3 GHz)		1125.5555.03
SMIQ04B (0.3 to 4.4 GHz)		1125.5555.04
SMIQ06B (0.3 to 6.4 GHz)		1125.5555.06
Accessories supplied	power cable, operating manual	
Options		
Reference Oscillator OCXO	SM-B1	1036.7599.02
FM/φM Modulator	SM-B5	1036.8489.02
Data Generator	SMIQB11	1085.4502.04
Memory Extension, 32 Mbit	SMIQB12	1085.2800.04
Fading Simulator, 6 paths	SMIQB14	1085.4002.02
Second Fading Simulator for 12 paths or 2 channels	SMIQB15	1085.4402.02
Noise Generator and Distortion Simulator	SMIQB17	1104.9000.02
RF and AF Rear Connectors	SMIQB19	1085.2997.02
Modulation Coder	SMIQB20	1125.5190.02
BER Measurement	SMIQB21	1125.5490.02
IS-95 CDMA	SMIQB42	1104.7936.02
W-CDMA (to NTT DoCoMo 1.0 / ARIB standard 0.0)	SMIQB43	1104.8032.02
W-CDMA (to 3GPP)	SMIQB45	1104.8232.02
Low ACP for IS-95 CDMA and W-CDMA	SMIQB47	1125.5090.02
Frequency upgrade 02B to 03B	SMIQU03	1125.5855.03
Frequency upgrade 03B to 04B [7]	SMIQU04	1125.5855.04
Frequency upgrade 04B to 06B [7]	SMIQU06	1125.5855.06
Modification Kit for Low ACP [7]	SMIQU47	1125.5149.02
Recommended extras		
19" Adapter	ZZA-94	0396.4905.00
Service Kit	SM-Z3	1085.2500.02
BNC Adapter for rear panel, D type connector PAR DATA	SMIQ-Z5	1104.8555.02
90° Power Splitter	SMIQ-Z9	1104.9580.02
Trolley for Transit Case	ZZK-1	1014.0510.00
Transit Case	ZZK-944	1013.9366.00
Service Manual SMIQ		1085.2445.24

---

[1] PEP = peak envelope power

[2] Data apply to RF≥5 MHz unless specified otherwise and for ATTENUATOR MODE NORMAL function

[3] Applies after a warm-up time of 1 hour and recalibration for 4 hours of operation with temperature variations of less then 5°C.

[4] CPDF = cumulative probability distribution function; levels referred to average value of output level

[5] Ratio of discrete and distributed component

[6] Contrast of LCD lower at higher temperature

[7] Factory installation only

[8] Spectrum analyzer settings RBW 30 kHz, VBW 300 kHz, detector RMS

[9] Typical value for QPSK modulation (crest factor approx. 4 dB), referred to average power from sum of carrier and noise power for C/N >5 dB. Carrier leakage deteriorates with increasing crest factor of modulation signal.

[10] For symbol rate <300 ksym/s.

[11] Cannot be fitted together with Digital Standard W-CDMA 3GPP (option SMIQB45).

[12] Cannot be fitted together with Digital Standard W-CDMA NTT DoCoMo (option SMIQB43).

[13] Spectral components exceeding max. IQ bandwidth will be suppressed.

[14] Additional error with ALC OFF <0,3 dB

Fax Reply (Vector Signal Generator SMIQ – Specifications)

☐ **Please send me an offer**

☐ **I would like a demo**

☐ **Please call me**

☐ **I would like to receive your free-of-charge CD-ROM catalogs**

Others: ______________________________
____
____

Name: ______________________________
Company/Department: ______________________________
Position: ______________________________
Address: ______________________________
____
____
Country: ______________________________
Telephone: ______________________________
Fax: ______________________________
E-mail: ______________________________

, 757.4582.22 Vector Signal Generator SMIQ – Specifications Trade names are trademarks of the c · Subject to change · Data without tolerances: typical values Printed in Germany 10/99 (Bi e)

ROHDE & SCHWARZ

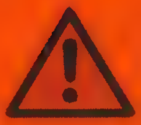
ROHDE&SCHWARZ GmbH & Co. KG · Mühldorfstraße 15 · D-81671 München · P.O.B. 80 14 69 · D-81614 München · Telephone +49 89 41 29-0
Internet: http://www.rsd.de · CustomerSupport: Tel. +49 1805 12 42 42, Fax +49 89 41 29-3777, E-mail: CustomerSupport@rsd.rsd.de

Safety Instructions

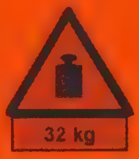
This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

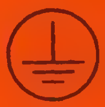
Safety-related symbols used on equipment and documentation from R&S:



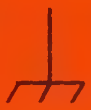
Observe operating instructions



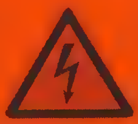
Weight indication for units >18 kg



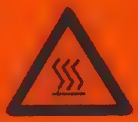
PE terminal



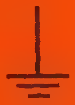
Ground terminal



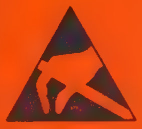
Danger! Shock hazard



Warning! Hot surfaces



Ground



Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, Pollution severity 2, overvoltage category 2, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. Any additional safety instructions given in this manual are also to be observed.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.

The Rohde & Schwarz quality management system is certified according to ISO 9001.

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.

Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

ROHDE & SCHWARZ

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 99015

This is to certify that:

Equipment type	Order No.	Designation
SMIQ02B	1125.5555.02	Vector Signal Generator
SMIQ03B	1125.5555.03	
SMIQ04B	1125.5555.04	
SMIQ06B	1125.5555.06	
SMIQB10	1085.5009.02	Modulation Coder
SMIQB11	1085.4502.02/.04	Data Generator
SMIQB12	1085.2800.02/.04	Memory Extension
SMIQB14	1085.4002.02	Fading Simulator
SMIQB15	1085.4402.02	Second Fading Simulator
SMIQB17	1104.9000.02	Noise Generator
SMIQB20	1125.5190.02	Modulation Coder
SMIQB46	1105.0006.02	Low ACP
SMIQB47	1125.5090.02	Low ACP

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1993 + A2 : 1995
EN50081-1 : 1992
EN50082-2 : 1995

Affixing the EC conformity mark as from 1999

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 1999-09-17

Central Quality Management FS-QZ / Becker

Supplement to Operating Manual
Vector Signal Generator SMIQ02B/03B/04B/06B
(Firmware-Version 5.10)

As far as the functionality of SMIQ is concerned, the following deviation from the operating manual has to be pointed out:

Option SMIQB21 – Bit Error Rate Test
1125.5490.02

Dear SMIQ Customer,

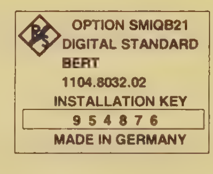
We are pleased that you have opted for Signal Generator SMIQ from Rohde & Schwarz. SMIQ is an advanced and versatile measuring instrument that can be easily adapted to future requirements.

If you have any suggestions on how to improve the control or measurement functions or if you experience a problem, please let us know so that we can take corresponding actions.
Please send us a detailed description of the problem, the conditions and the software version concerned. For any further wishes or suggestions contact your Rohde & Schwarz sales office or the Munich headquarters under the fax number

+49-89-4129-3439

1 Installing Option SMIQB21

Software option SMIQB21 has to be enabled by entering a key upon installation. An option label containing the installation key is supplied and has to be affixed to the rear of SMIQ for service and repair purposes.
As a prerequisite, SMIQ must be fitted with hardware option SMIQB20 (modulation coder).

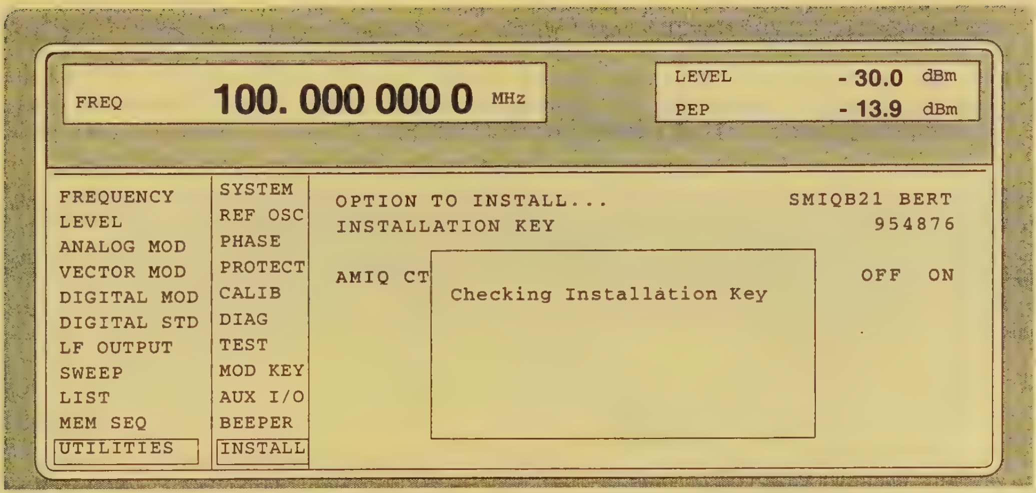

OPTION SMIQB21
DIGITAL STANDARD
BERT
1104.8032.02
INSTALLATION KEY
9 5 4 8 7 6
MADE IN GERMANY

<== Example

Fig. 1 Option label with example of installation key

Enabling the option
(see Fig. 2)

- ➢ Switch on SMIQ.
- ➢ Call UTILITIES menu (select with rotary knob, confirm with [SELECT] key).
- ➢ Call INSTALL menu ==> [SELECT].
- ➢ Call OPTION TO INSTALL menu ==> [SELECT].
- ➢ Select option SMIQB21 BERT ==> [SELECT].
- ➢ Enter the 6-digit installation key shown on the option label into the INSTALLATION KEY line. Then press the [ENTER] key.
- ➢ You will receive a message confirming that the installation key has been verified and the option is installed.
- ➢ To make the option available, the unit has to be switched off and on again.
- ➢ Once the installation has been successfully completed, BER measurement can be selected from the main menu.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 13.9 dBm

OPTION TO INSTALL... SMIQB21 BERT

INSTALLATION KEY 954876

Checking Installation Key

Fig. 2 Enabling option SMIQB21

Once the installation has been completed, the availability of the new option can be checked in the module list in the UTILITIES DIAG CONFIG menu.

1.1 Connector

The clock and data signals output by the DUT must have TTL level and are connected to the BER (bit error rate) input, a 9-contact SUB-D connector at the rear of the unit labelled BER. Pin assignment is as follows:

	SUB-D connector	**Adapter cable** **Order No. 1110.3551.00**
1,2,3,4,5	Ground	Screen
6	Bit clock input	CLOCK
7	Data input	DATA
8	Data enable input	DAT ENAB
9	Restart	RES

Polarity of clock and data signals, the PRBS polynomial used and the integration time can be set by manual or remote-control commands. The input signals are **not** terminated in the SMIQ but applied to ICs of type 74LVT14 via a 220 Ω resistor. A cable is supplied with the option. Its contacts are assigned to BNC connectors as shown in the above table.

2 Manual Operation

2.1 Measurement of the Bit Error Rate

Option SMIQB21 allows an evaluation of the signal demodulated and decoded by the DUT. For this purpose, a PRBS-modulated data sequence (PRBS = Pseudo Random Binary Sequence) is sent to the DUT. This data sequence can be generated continuously (by means of option SMIQB20) or in sections, in the latter case by means of option SMIQB60 using a loaded waveform.
The PRBS data sequence is decoded by the DUT and sent to the SMIQ in the form of clock and data signals. The SMIQ synchronizes to the known PRBS sequence and counts the bit errors.

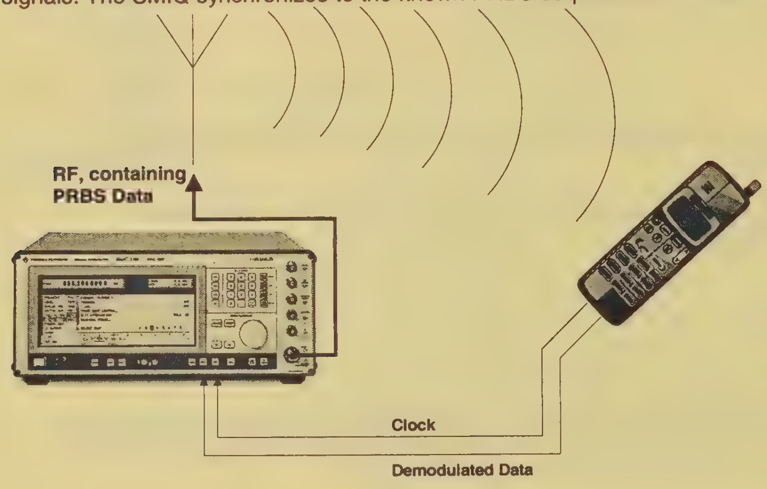


Fig. 3 Measurement of BER

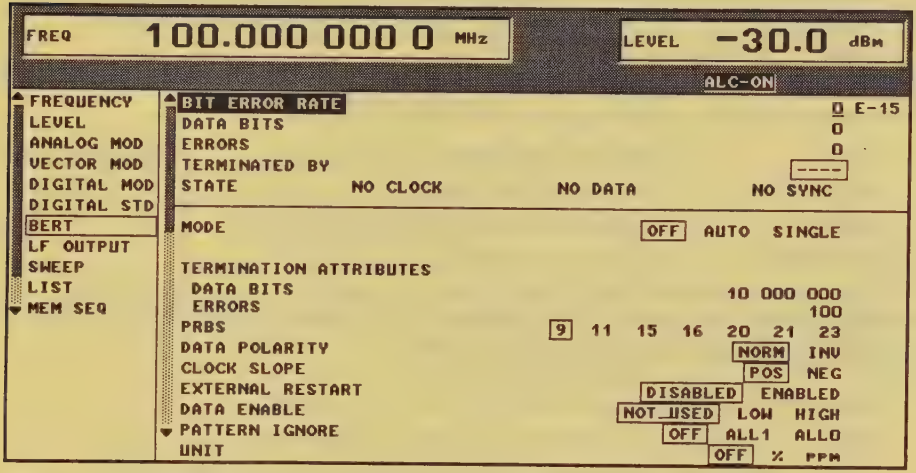
Termination of a measurement can be induced by various criteria. With option SMIQB21, measurements can be stopped either manually or because of one of the following two criteria: a user-defined number of data bits has been transmitted or a maximum number of errors has been detected.

By means of the RESTART function (eg for IQ signals that are not generated continuously and therefore do not contain integer multiples of PRBS sequences) BER results can be integrated onto the (partial) sequences. In this way, long BER measurements can also be performed on short IQ signals (which normally do not allow BER measurement because the PRBS sequence is not continuous).

The BER measurement can also be performed separately (with data from another source).

2.2 Operating Menu

In the operating menu, the configuration for the BER measurement is made and the results are displayed.



```
FREQ     100.000 000 0 MHz              LEVEL   -30.0 dBm
                                                 ALC-ON
BIT ERROR RATE                                          0 E-15
DATA BITS                                               0
ERRORS                                                  0
TERMINATED BY                                        ----
STATE            NO CLOCK        NO DATA        NO SYNC

MODE                                      OFF   AUTO   SINGLE

TERMINATION ATTRIBUTES
 DATA BITS                                       10 000 000
 ERRORS                                                 100
PRBS                          9   11   15   16   20   21   23
DATA POLARITY                                    NORM   INV
CLOCK SLOPE                                       POS   NEG
EXTERNAL RESTART                          DISABLED   ENABLED
DATA ENABLE                           NOT_USED   LOW   HIGH
PATTERN IGNORE                              OFF   ALL1  ALL0
UNIT                                            OFF   %   PPM
```

Fig. 4 Operating menu for BER measurement

In the upper section of the menu (display area), the measurement results are displayed together with the way in which they have been established, and additional information on the applied signal. In the lower section, settings can be made.

BIT ERROR RATE (BER)	Cyclic display of the measured bit error rate, the ratio of detected errors to transmitted data bits.
DATA BITS	Number of transmitted data bits.
ERRORS	Number of detected errors.
TERMINATED BY	The displayed measurement result was obtained as follows:

NUMBER OF DATA BITS	The defined number of data bits was reached.
NUMBER OF ERRORS	The defined number of errors was detected.
USER	The measurement was interrupted manually by the user.
----	Measurement in progress.

STATE

The status information described in the following tells the user whether the BER measurement is working. The STATE display signals the status of clock line, data line and synchronization. If the clock signal changes, CLOCK is indicated as status, otherwise NO CLOCK. The same applies to the data display DATA or NO DATA. NO DATA may be displayed because DATA ENABLE is not set to NOT USED or the data enable signal does not enable the data. SYNC indicates a successful attempt of PRBS synchronization by the analyzer. It is not before all three of CLOCK, DATA and SYNC are "active" that the measurement results are valid.

CLOCK	Change of clock signal.
NO CLOCK	No change of clock signal.
DATA	Change of data signal.
NO DATA	No change of data signal.
SYNC	Successful synchronization to PRBS.
NO SYNC	No synchronization.

The seven parameters listed above (data bits, error bits, error rate, attribute "terminated", attribute CLOCK, attribute DATA, attribute SYNC) are jointly polled by the IEC/IEEE bus query `:BERT:RES?` .

MODE

Setting for the BER measurement.

OFF	Terminate measurement.
AUTO	Continuous measurement of bit error rate. If one or both criteria for termination are fulfilled, a new measurement is initiated automatically. Depending on the settings made, a measurement may take considerable time. During the first measurement, intermediate results are displayed. For the measurements that follow, only the final results are shown. The parameters DATA BITS and ERRORS are continuously updated and indicate the relative values for the measurement in progress.
SINGLE	Single measurement of bit error rate. During the measurement, SMIQ cyclically displays the updated values for rate, number of errors and number of data bits. If any one of the termination criteria (TERMINATION ATTRIBUTES [DATA BITS] and TERMINATION ATTRIBUTES [ERRORS]) is reached, the measurement is stopped. A single measurement is initiated only if the menu item EXECUTE SINGLE is selected.

IEC/IEEE-bus command `:BERT:STAT ON`
`:BERT:SEQ SING`

EXECUTE SINGLE➤

Initiates a single BER measurement. This menu item is only displayed if MODE = SINGLE is set.

IEC/IEEE-bus command `:TRIG:BERT:IMM`

TERMINATION ATTRIBUTES

DATA BITS Setting the termination criterion "Number of transmitted data bits".

IEC/IEEE-bus command `:BERT:SET:MCO <1>`

ERRORS Setting the termination criterion "Maximum number of detected errors".

IEC/IEEE-bus command `:BERT:SET:MERR <1>`

PRBS

Setting the period length of data: 9, 11, 15, 16, 20, 21, 23 bits.

Note: Data inversion for PRBS15 and PRBS23, which is contained in the standard, is performed automatically when the PRBS is selected. DATA POLARITY remains unaffected.

IEC/IEEE-bus command `:BERT:SET:TYPE PRBS9`

DATA POLARITY

Setting the data bit polarity.

NORM	Normal polarity
INV	Inverted polarity

IEC/IEEE-bus command `:BERT:SET:DATA[:POL] NORM`

CLOCK SLOPE

Setting the clock edge polarity.

POS	Rising edge
NEG	Falling edge

IEC/IEEE-bus command `:BERT:SET:CLOC[:POL] RIS`

EXTERNAL RESTART

Activating/deactivating an external restart of the BER measurement.

Note: *An enabled RESTART works always independently of PATTERN IGNORE or DATA ENABLE.*

DISABLED	Deactivated
ENABLED	Activated

IEC/IEEE-bus command `:BERT:SET:REST INT`

DATA ENABLE

Setting the polarity of the DUT's DATA ENABLE signal.

Note: *If the data are not enabled, the execution of the BER measurement is stopped completely. The identification circuit for PATTERN IGNORE as well as the PRBS generator of the BER measurement wait as long as data are not enabled. If the data are enabled, the measurement is continued.*

NOT USED	Irrespective of the data enable signal applied, all data at the BERT data input are used for the BER measurement.
LOW	Only the data applied at the BERT data input with a low-level data enable signal are used for the BER measurement.
HIGH	Only the data applied at the BERT data input with a high-level data enable signal are used for the BER measurement.

IEC/IEEE-bus command `:BERT:SET:DEN OFF`

PATTERN IGNORE

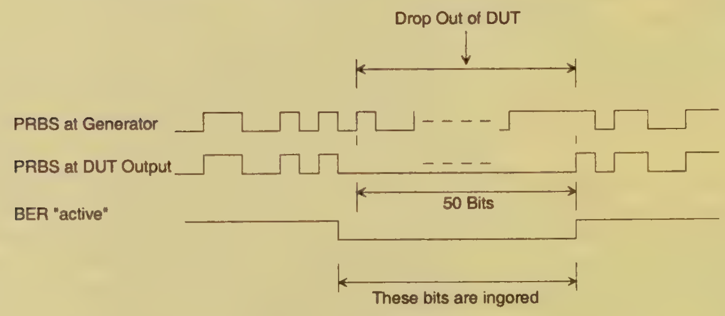
In the event of a so-called frame error (eg an error detected in the check sum), some mobile radio standards communicate a complete "0" or "1" frame to the BERT instead of the detected frame data. This is to signal to the BERT that this frame is not to be used for the BER measurement.

OFF	PATTERN IGNORE is not active.
ALL 1	Bit sequences consisting of 31 or more subsequent "1" data are not used (ie ignored) for the BER measurement.
ALL 0	Bit sequences consisting of 31 or more subsequent "0" data are not used (ie ignored) for the BER measurement.

IEC/IEEE-bus command `:BERT:SET:IGN OFF`

Notes:

- *While ignoring the bits, the PRBS generator for the BER measurement keeps running. Following the "0" or "1" sequence, the BER measurement is continued as if the ignored sequence had contained PRBS data.*
- *If PATTERN IGNORE is switched on, synchronization time is 32 bits longer.*
- *If PATTERN IGNORE and RESTART are active at the same time, the presence of the restart signal causes the measurement to stop **immediately**. None of the 32 bits within the PATTERN IGNORE detector is evaluated.*
- *If DATA ENABLE and PATTERN IGNORE are active at the same time, DATA ENABLE is given priority, ie bits that are not enabled are not examined for "0" or "1" sequences.*



Example 50 bits were set to "0" by the DUT. These 50 bits plus the preceding "0" are ignored in the measurement.

UNIT

Setting the unit for displaying the bit error rate.

OFF	No unit, decade values
%	Relative frequency in percent
ppm	Relative frequency in parts per million

IEC/IEEE-bus command `:BERT:UNIT OFF`

2.3 Signal Path and Waveform

See also section 1.1, "Connector".

Test setup

The signal is computed using one of the modulation sources listed above and then output by the SMIQ and sent to the DUT (device under test). The latter demodulates the source bits contained and returns them to SMIQ together with a transfer clock. In the SMIQ, the data bits are checked for errors. The total of the transmitted bits and the faulty bits are counted. The quotient of error bits/total bits is the BER.

PRBS data

To be able to detect faulty bits in a BER measurement, the data generation polynomial must be known. Data are calculated with the aid of so-called pseudo-random binary sequences (PRBS). These are quasi-random bit sequences which are repeated according to the selected polynomial.

An advantage of the PRBS data is that the bit error detector has only to know the polynomial but not the total sequence. Furthermore, the analysis can be started anywhere in the bit stream, ie the bit-stream source and the analyzer need not be synchronized.

Transfer clock

Should the DUT not provide a transfer clock, the bit clock can be taken from the output connector PAR-DATA for the generation of the signal using option SMIQB11 (DGEN). If AMIQ is used as the IQ source, a marker channel may be programmed as clock output. However, the clock-to-data ratio is to be observed.

2.4 Test Method

Generation of PRBS data

PRBS data are generated with the aid of a shift register with feedback points determined by the polynomial. A random start status yields one subsequent state. The start status and therefore the subsequent status occur only once in the whole sequence.

Feedback of data stream

If the shift register is filled with a data sequence at the beginning of a measurement and the register is then switched from "filling" to "feedback", the register generates the same data sequence as it expects to receive. Faulty bits can thus be identified and counted by comparing the received data to the results obtained from the shift register.

This method has the advantage that the analyzer can be used separately from signal generation (logically and with respect to time). Consequently, delays caused by the DUT, the use of other PRBS sources and transmission over long distances with spatially separated transmitter and receiver, do not cause any problems.

Errors in start status

If a bit error is already present in the start status (faulty bits are not detected during filling), the shift register starts from an incorrect position in the data sequence. As a result all subsequent states will be faulty. Since, statistically, every second bit is faulty, the BER will be about 50%. In this case the measurement is started again automatically, without the user realizing.

BER measurement with uninterrupted repetition of the random sequence

The (non-integrating) BER measurement operates on the basis of random sequences that are run continuously. These sequences are either generated continuously or by cyclic output of a stored sequence, with the number of encoded bits being an integer multiple of the length of the random sequence. The length of the random sequence is 2 to the power of the degree of the polynomial less 1, ie PRBS9 has a length of 511 (2^9 equals 512 less 1).

This type of BER measurement is selected by either setting External Restart to DISABLED or by issuing the IEC/IEEE-bus command `:BERT:SET:REST INT`. The CLOCK and DATA lines are sufficient for this measurement.

The data to be analyzed are interrupted by other data

The data bits contain data like sync, preambles, other channels, etc in addition to the PRBS data. To mark the data to be evaluated, a DAT ENABle signal has to be sent with the data. Either this DAT ENABle signal is generated by the DUT or an additional channel of the IQ source is used (eg marker channel of AMIQ).

The BER measurement in the SMIQ has to be adjusted for the use of a DAT ENABle signal; this is done by setting the required polarity in the menu or by means of IEC/IEEE-bus command (`:BERT:SET:DEN Low|High`). Data Enable = high means that data are only counted by the DUT and subjected to the BER measurement if the data enable input is set to 1.

BER measurement with interrupted random sequence - integrating BER measurement

Due to the type of data, oversampling and the finite memory length of SMIQ (option SMIQB60) or AMIQ, it may happen that the generated random sequence is not cyclically repeated at the memory wrap-around but has a break at this point. In a normal BER measurement operating exclusively with CLOCK and DATA signals, a break of this kind would lead to approx. 50% faulty bits due to the loss of synchronization.

A random sequence with a break can be processed by means of the **integrating BER measurement** and is switched on in the menu under EXTERNAL RESTART (or by the remote-control command `BERT:SETup:RESTart EXTern`). The BER measurement is to be stopped in time and then restarted at the beginning of the data sequence. The measurement is stopped and started via a signal at the RES input (pin 9 of SUB-D connector): A transition from logic 0 to 1 causes a partial result to be generated and the measurement to be stopped. A transition from 1 to 0 starts the measurement for the next sub-interval. This measurement is synchronized anew.
This input is best connected to an AMIQ marker channel or the SMIQ trigger output, with a single 1 encoded both at the start and at the end of the data sequence. This causes the BER measurement to stop briefly at memory wrap-around (the break) and start again. The partial results are integrated.

When the signals are interrupted by other data (eg preambles), these data will normally cause bit errors. The BER measurement for these data can then be interrupted using the data enable input .

In the integrating BER measurement, partial BER results are added up (controlled by a signal at the RES input) until the predefined total number of data or error bits is attained or exceeded.

Note:

Since the test hardware can be programmed flexibly, other bit error measurement techniques such as comparison with the output pattern, masking of certain time and data ranges, are also possible. In this matter, please contact your nearest R&S representative.

2.4.1 PRBS Polynomials

For generating and testing the PRBS, a shift register with feedback is used. The feedback depends on the type of polynomial used. The sequence length of a generator is the result of $2^n - 1$, n being the degree of the polynomial.

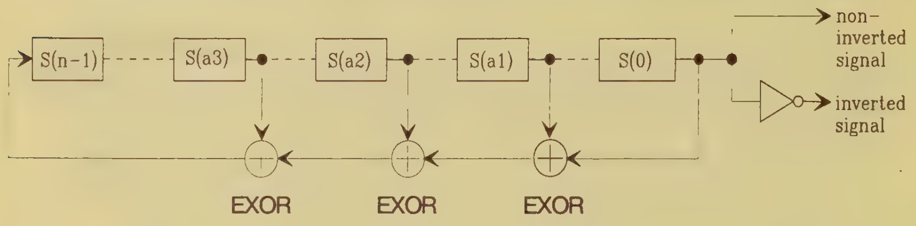


Fig. 5 PRBS polynomials

PN generator	N	a1	a2	a3	Output	acc. to standard
PN9	9	4	-	-	non-inverted	ITU-T Rec. O.153 Fascicle IV.4
PN11	11	2	-	-	non-inverted	ITU-T Rec. O.152 Fascicle IV.4
PN15	15	1	-	-	inverted	ITU-T Rec. O.151 Fascicle IV.4
PN16	16	5	3	2	non-inverted	--
PN20	20	3	-	-	non-inverted	ITU-T Rec. O.153 Fascicle IV.4
PN21	21	2	-	-	non-inverted	--
PN23	23	5	-	-	inverted	ITU-T Rec. O.151 Fascicle IV.4

2.4.2 Measurement Result, Accuracy, Measurement Time

Value range

Measurement results for the bit error rate (ie the quotient of error bits and total bits) are usually found between 10^{-2} and 10^{-9}. This means that a large number of bits may have to be checked before a faulty bit is detected. Because of the large number of bits involved the measurement time is usually very long.

Since 32-bit-wide counters are used for the total bits and the error bits, the maximum measurement time is 4.29×10^9 bits.

Statistics

The BER measurement measures statistical bit errors, ie errors which do not occur at regular intervals but at random. Although a single measurement determines the exact number of errors in the measured interval, a statistically reliable BER can only be obtained when a sufficient number of errors occurs in the observed interval. Only this ensures that the single BER measurement result approaches the true error rate with high probability .

Termination criteria

To keep the measurement time short with low and high bit error rates, two termination criteria have been defined in SMIQ for the BER measurement.

- Criterion 1: Total number of bits
  The measurement is terminated when the specific number of data bits is reached. Due to this criterion the BER measurement is reliably stopped after the specified number of bits even if no error or only a few errors were detected; the measurement result is not statistically reliable (few bit errors).
- Criterion 2: Number of errors

  The measurement is terminated when the specified number of bit errors is detected. With this criterion, the measurement is rapidly terminated when high bit error rates occur. Since a great number of errors is counted, the measurement result is statistically reliable.

The two criteria are used together. The criterion which finally yields a valid result is indicated in the results screen ("Measurement terminated by...").

Interruption of measurement

At the end of a measurement, the restart of a new one is delayed until the first measurement result has been queried with `:BERT:RES?`. The resulting brief measurement interruption is irrelevant because the subsequent measurement will be synchronized within 24 data bits.

2.4.3 Possible Problems with BER Measurement and Related Solutions

Fault	**Possible cause**	**Fault description/remedy**
BER measurement does not synchronize	No signals received from DUT or the signal level is not correct.	➢ Check displays for activity at BER measurement inputs. If a status is displayed (Clock, Data, Sync) for a line, there is activity.
	The selected PRBS is not correct.	Normally, the PRBS on which the data are based is used as the default setting. If the PRBS is changed, the BER measurement cannot synchronize to the data (because the polynomial is not correct).
	A wrong clock edge is used, which violates setup or hold times.	➢ Check the bit clock signal, the data signal and the data enable signal, if any, on an oscilloscope. The fault may also be caused by reflections on the clock line, which switch the data signal twice into the BER measurement, eg on lines without termination. The SMIQ input is **not** terminated.
	Incorrect polarity of data signal (or data enable signal).	In this case the PRBS cannot synchronize. Note that an inversion of the output signal specified for some cases by the PRBS standard is performed automatically upon PRBS selection. Manual inversion of the data signal is therefore not required.
	A bit error occurs during synchronization (nine data bits with PRBS9)	The BER measurement is started at a wrong position so that about 50% of the subsequent data bits are identified as faulty.
No clock received from DUT	When testing RF components, clock recovery is not available. An external clock is however required for clocking the data during the BER measurement	Instead of a clock recovery circuit, the bit clock at the PAR-DATA connector of the SMIQ may be possibly used as a replacement. This is possible if DGEN (SMIQB11) is used as a data source. However, this bit clock is not possible with all modulation types. Also, the delay between data and clock has to be observed.
Measured BER too high	The data are clocked with the wrong edge and/or the eye aperture of the data is not optimally met.	➢ Check the clock/data relationship by means of an oscilloscope and set optimum timing.
	BER measurement does not synchronize	If data that are not cyclically continued (ie when a break occurs at the memory wrap-around), the measurement will identify about 50% of the bits as faulty after the wrap-around. Make sure the measurement is started optimally at the beginning of the sequence by means of a signal on the REStart line (see: "BER measurement with interrupted random sequence – integrating BER measurement" in section 2.4, "Test Method").

3 Remote Control - SOURce:BERT-Subsystem

Command	Parameter	Default Unit	Remark
[:SOURce]			
:BERT			
:STATe	ON | OFF		
:SEQuence	AUTO | SINGle		
:SETup			
:MCOunt	1 to 4294967294		
:MERRor	1 to 4294967294		
:TYPE	PRBS9 | PRBS11 | PRBS15 | PRBS16 | PRBS20 | PRBS21 | PRBS23		
:DATA			
[:POLarity]	NORMal | INVerted		
:CLOCk			
[:POLarity]	RISing | FALLing		
:RESTart	INTernal | EXTernal		
:DENable	OFF | LOW | HIGH		
:MASK	OFF | LOW | HIGH		Alias
:IGNore	OFF | ONE | ZERO		
:UNIT	OFF | PCT | PPM		
:STARt	(without)		
:STOP	(without)		
:RESULT?			Query only

:BERT:STATe ON | OFF

This command switches the bit error rate test on or off. The command `:BERT:STARt` sets the status internally to `ON`, while the command `:BERT:STOP` sets it to `OFF`.

Example: `:BERT:STAT ON` *RST value is OFF

:BERT:SEQuence AUTO | SINGle

This command switches between continuous (`AUTO`) and single measurement (`SINGle`). A single measurement is terminated once the set number of data bits or error bits is reached. The continuous measurement is a sequence of automatically started single measurements.

By means of the command `:BERT:STARt`, the status is internally set to `AUTO`.

Example: `:BERT:SEQ SING` *RST value is AUTO

:BERT:SETup:MCOunt 1 to 4294967294

This command sets the total number of data bits to be measured (data excluded by `:BERT:SETup:DENable` do not count). When the internal data counter reaches or – in integrated BER test – exceeds this number, the single BER measurement is terminated. If this is followed by the query `:BERT:RES?`, SMIQ signals with the fourth result that a BER measurement has been completed. This fourth result then has the value 1.

Valid value range: 1 to 4294967295 (2^{32}-1)

Example: `:BERT:SET:MCO 1e6` *RST value is 10.000.000

:BERT:SETup:MERRor 1 to 4294967294

This command sets the number of error bits to be measured. When the internal bit error counter reaches or – in integrating BER test – exceeds this number, the SMIQ responds to a `:BERT:RES?` query by signalling with the fourth result = 1 that a single BER measurement has been terminated.

Valid value range: 1 to 4294967295 (2^{32}-1)

Example: `:BERT:SET:MERR 100` *RST value is 100

:BERT:SETup:TYPE PRBS9 | PRBS11 | PRBS15 | PRBS16 | PRBS20 | PRBS21 | PRBS23

With this command, various sequence lengths can be set for the pseudo-random bit sequence. The data generated by the PRBS generator are used as a reference.

Example: `:BERT:SET:TYPE PRBS15` *RST value is PRBS9

:BERT:SETup:DATA[:POLarity] NORMal | INVerted

This command defines the polarity of the external data signal.

NORMal: High level stands for a logic 1, low level for a logic 0.

INVerted: Low level stands for a logic 1, high level for a logic 0.

Example: `:BERT:SET:DATA INV` *RST value is NORM

:BERT:SETup:CLOCk[:POLarity] RISing | FALLing

This command defines which edge of the externally fed clock signal is active.

Example: `:BERT:SET:CLOC FALL` *RST value is RIS

:BERT:SETup:RESTart INTernal | EXTernal

INTernal The reset signal for the BER test is generated internally by the program. This setting is suited for random sequences fitting cyclically into the SMIQ memory and therefore allowing an uninterrupted repetition of the random sequence.

EXTernal If the random sequence cannot be continued without interruption at memory wrap-around, the BER test has to be stopped in time and then restarted at the beginning of the data sequence. The measurement is stopped and started via a 0-1-0 edge at the restart input. Partial BER results (data and error bits) are added up until the predefined total number of data or error bits is reached or exceeded. These partial results are not affected by a restart.

Example: `:BERT:SET:RES EXT` *RST value is INT

:BERT:SETup:DENable OFF | LOW | HIGH

The SMIQ has an input (data enable) allowing the temporary suspension of the BER test for processing data bursts or data interrupted by other data. This command configures this input.

OFF	Any signal applied to the input is ignored; all data are used for the BER measurement.
HIGH	If a high level signal is applied to the input, its data bits are counted and the bit errors detected and counted. If a low level signal is applied, the measurement is interrupted.
LOW	If a low level signal is applied to the input, its data bits are counted and the bit error detected and counted. If a high level signal is applied, the measurement is interrupted.

Example: `:BERT:SET:DEN HIGH` *RST value is OFF

:BERT:SETup:MASK OFF | LOW | HIGH

This command is equivalent (alias) to the command `:BERT:SETup:DENable` described above.

Example: `:BERT:SET:MASK HIGH` *RST value is OFF

:BERT:SETup:IGNore OFF | ONE | ZERO

This command determines what to do with faulty data (frame errors) that were set to 0 or 1.

OFF	Pattern Ignore is not active.
ONE	Bit sequences consisting of 30 or more subsequent "1" data are not used (ie ignored) for the BER test.
ZERO	Bit sequences consisting of 30 or more subsequent "0" data are not used (ie ignored) for the BER measurement.

Example: `:BERT:SET:IGN ONE` *RST value is OFF

:BERT:UNIT OFF | PCT | PPM

This command sets the unit for displaying the error rate. It is only for display on SMIQ; it has no effect on results queried by `:BERT:RES?`.

Example: `:BERT:SET PCT` *RST value is OFF

:BERT:STARt

This command starts a bit error rate test. The command `:BERT:STAT` is set to ON and `BERT:SEQ` to AUTO.

Example: `:BERT:STAR`

:BERT:STOP

The command stops an ongoing bit error rate test. If no measurement is in progress, this command has no effect. `:BERT:STAT` is set to `OFF`.

Example: `:BERT:STOP`

:BERT:RESult?

This query refers to the result of the most recent BER measurement. The response consists of seven results separated by commas. In the first measurement following the start, intermediate results for the number of data bits, error bits and error rate are also queried. In the following measurements (only for `:BERT:SEQ AUTO`), only the final results of each single measurement are queried.

Example: `:BERT:RES?`

Response: `"10000,5,5E-4,1,1,1,1"`

Result: `1    ,2,3   ,4,5,6,7`

Result 1	Number of data bits from current query.
Result 2	Number of error bits from current query.
Result 3	Error rate. If no termination criterion has been reached since the beginning of the BER test, the current quotient of "Number of error bits" and "Number of data bits" is entered. As soon as at least one final result has been reached in continuous measurement, the most recent final result is entered. This means the error rate displayed changes less rapidly.
Result 4	1 A BER measurement has been terminated, ie the number of data bits or error bits predefined by commands `:BERT:SET MCOunt <n>` or `:BERT:SET MERRor <n>` is reached, or the measurement was stopped by the command `:BERT:STOP`. 0 The BER measurement has not been terminated.
Result 5	1 Following the start of a BER measurement (by the command `:BERT: STARt`), an edge was detected on the clock line. 0 The clock line is not active.
Result 6	1 Following the start of a BER measurement (by the command `:BERT: STARt`), a data change edge was detected on the data line. This data change only refers to clocked data. If there is no clock, no data change is detected. 0 The data line is not active.
Result 7	1 The BER measurement is synchronized, ie both clock and data line are active and the "Number of error bits" to "Number of data bits" ratio is better than 0.1, so the measurement result can be assumed to be realistic. 0 The BER measurement is not synchronized.

1 Preparation for Use

1.1 Putting into Operation

Before putting the SMIQ into operation, please make sure that

- the covers of the casing are put on and screwed,
- the ventilation openings are free,
- no signal voltage levels exceeding the permissible limits are applied at the inputs,
- the outputs of the instrument are not overloaded or connected incorrectly.

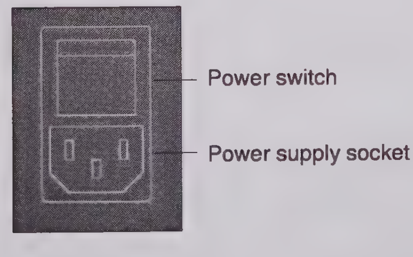
If these points are not observed, the instrument might be damaged.

1.1.1 Supply Voltage

The SMIQ can be operated at a.c. systems from 90 to 132 V and 180 to 265 V at system frequencies from 47 to 440 Hz. The power supply socket is situated at the rear of the instrument. The instrument automatically sets itself to the voltage applied within the permissible voltage ranges. It is not necessary to set the instrument to a certain supply voltage.

1.1.2 Switching On/Off the Instrument

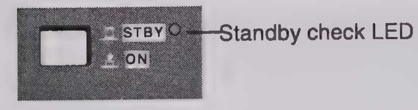
Power switch at the rear of the instrument



Switch on/off: ➤ Press power switch at the top (I) / bottom (0)

The power switch can remain switched on permanently. Switching off is only necessary when the instrument is to be completely disconnected from the mains.

On/off switch at the front of the instrument



Switch on: ➤ Press switch.
The instrument is ready for operation.

Switch off: ➤ Release switch.
The instrument assumes the STANDBY mode.

1.1.3 Initial Status

Upon switching on, the instrument either automatically assumes the status which was set when it was switched off (parameter POWER-ON STATE PREVIOUS SETTING in LEVEL-LEVEL menu) or the RF output is disconnected (POWER-ON STATE RF OFF).
If the instrument need not to be operated from the initial status any further, a defined default status should be established by pressing the [PRESET] key prior to further settings.

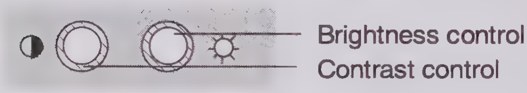
STANDBY Mode

In the STANDBY mode the optional reference oscillator (option SM-B1) remains switched on, which increases frequency accuracy.

Frequency accuracy after switching on when the oven-controlled reference oscillator is fitted (option SM-B1)

When switching on from the STANDBY mode, the specified frequency accuracy is reached immediately. If the power switch was switched off, the reference oscillator needs some minutes of warm-up time to reach its nominal frequency. During this period of time, the output frequency does not yet reach its final value either. In the status line in the header field of the display the message "OVEN COLD" is displayed for this time.

1.1.4 Setting Contrast and Brightness of the Display



Contrast and brightness of the display can be set by means of the contrast and brightness controls situated below the display.

1.1.5 RAM With Battery Back-Up

The SMIQ has a static read-write memory (CMOS-RAM) with battery back-up, in which 50 different complete settings of the instrument can be stored (cf. Chapter 2, section "Storing and Calling of Instrument Settings"). In addition, all data and/or lists the user enters himself, such as for list mode, memory sequence, and user correction of the level, are stored in the RAM. Further, all data of the calibrations running within the instrument in the SMIQ are stored in the RAM (cf. Chapter 2, section "Calibration").

A lithium battery with a service life of approx. 5 years serves to supply the RAM with power. When the battery is discharged, the data stored will be lost. For exchange of the battery see Service Manual.

1.1.6 Preset Setting

A defined setting status is achieved by pressing the [PRESET] key.

Preset Status:

RF frequency	100 MHz
RF level	-30 dBm
Reference frequency	internal, adjustment off
Offsets	0
Modulations	switched off
Transient-free level setting	switched off, level attenuator mode: AUTO
Internal level control	level ALC: AUTO
User correction	level UCOR: OFF
LF output	switched off
Sweep	switched off
List mode	switched off
Memory sequence	switched off
Suppression of indications	system security: unaltered
Protection of calibration data	protection lock: unaltered
Settings stored	unaltered
Data, lists etc. stored	unaltered
IEC-bus address	unaltered
Beeper	unaltered

All parameters and circuit states, even those of operating modes which are not activated, are preset by means of Preset.

The presettings going beyond the above list can be seen from the menu representations as of Section 2.4 which each indicate the Preset setting status.

1.2 Functional Test

On switching on the instrument and permanently during operation, the SMIQ carries out a self test. The ROM contents as well as the battery of the non-volatile RAM are checked on switching on the instrument and the RAM contents with every calling the memory. The most important instrument functions are automatically monitored during operation.

If an error is detected, the message "ERROR" is displayed in the status line. For further identification of the error, press the [ERROR] key. Thereupon a description of the error/s is displayed (cf. Chapter 2, section "Error Messages"). Return to the menu exited by pressing the [RETURN] key.

If required, the self tests can be induced purposefully. See Chapter 4, section "Functional Test".
Further, internal test points can be polled by the user and the results be read out and displayed. See Chapter 2, section "Voltage Indication of Test Points".

1.3 Fitting the Options

Due to its variety of options, the SMIQ offers the possibility of providing the instrument with the equipment exactly corresponding to the application. Newly fitted options are automatically recognized and the relevant parameters added in the menu.

After every change of the instrument configuration, the CMOS RAM has to be cleared as the storage data shift:

- Switch off the instrument
- Switch the instrument on again with the [RESET] key pressed

The internal calibration routines VECTOR MOD, VCO SUM, and LEV PRESET now have to be called up again to restore the cleared calibration values.
These routines are accessible via menu UTILITIES-CALIB (see also Chapter 2, section "calibration"). The calibration routines have to be carried out in the following order:

1. VCO SUM (Summing loop)
2. VECTOR MOD
3. LEV PRESET

1.3.1 Opening the Casing

Caution:
Prior to opening the SMIQ, unplug the power connector.

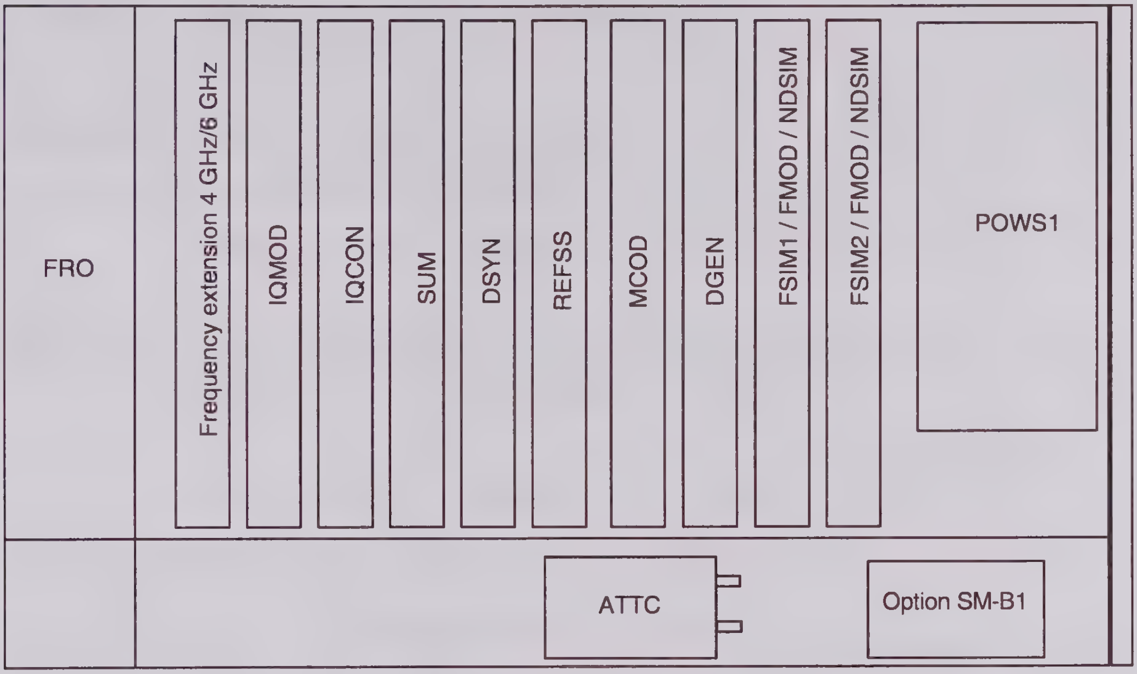
Remove paneling

- Remove four screws in the two tilt feet at the rear of the instrument.
- Remove the upper paneling towards the top and rear.
- Turn the instrument.
- Remove the lower paneling towards the top and rear.

Open ventilation ducts

When an option is fitted at a slot which has not been used up to now, the appropriate ventilation duct of the plexiglas plate at the left in the casing frame must be opened. The openings are pre-punched so that the respective part is easy to break out.

1.3.2 Overview of the Slots



FRO = front unit
FMOD = FM/PM modulator
IQMOD = I/Q modulator
IQCON = I/Q converter
SUM = summing loop
DSYN = digital synthesis
REFSS = reference/step synthesis

MCOD = modulation coder
DGEN = data generator
FSIM = fading simulator
POWS1 = power supply
ATTC = attenuator
NDSIM = Noise generator and distortion simulator

Fig. 1-1 SMIQ, view from the top

1.3.3 Option SM-B1 - Reference Oscillator OCXO

Fitting the option

- ➢ Fasten the option at the back end of the lateral opening by means of the screw threads provided there.
- ➢ If the two last slots are both occupied, one of these modules must be removed temporarily.
- ➢ Feed ribbon cable W710 through the rear square cut-out to the motherboard, insert into connector X22 and snap in the locking.
- ➢ Feed coaxial cable W170 from socket X711 of the option through the second cut-out along the rear transverse panel to connector X74 at the A7 module, reference/step synthesis, via the motherboard and insert there.

Set tuning voltage and calibrate OCXO

The crystal oscillator was factory-tuned to nominal frequency and the appropriate tuning voltage indicated on the cover of the module. The calibration value now has to be calculated from this value and transferred to the memory of the signal generator.

Calculate calibration value

The tuning voltage is generated by a 12b-bit-D/A converter which is scaled such that a tuning voltage of 12 volts is generated with calibration value (CALIBRATION DATA) 4000.
The calibration value is thus calculated from the tuning voltage (V_{tun}) as follows

$$\text{CALIBRATION DATA} = V_{tun} \times 4000 \ / \ 12$$

For checking purposes, the voltage at pin 16 of plug X22 on the motherboard can be remeasured and corrected if necessary. A check by means of frequency measurement may only be made after a warm-up of 2 hours and against a calibrated reference.

Store calibration value

- ➢ Unlock protection level 2 with code 250751.
- v Call menu UTILITIES-CALIB-REF OSC.
- ➢ Enter the calculated calibration voltage with CALIBRATION DATA by means of the rotary knob or keypad.
- ➢ Select STORE CALIBRATION DATA
- ➢ Terminate entry using the [SELECT] key
  The new calibration value is stored in the EPROM.

Note: *The flash EPROM does not permit the deletion of individual data. Thus new memory space is occupied for each calibration. If there is no memory space available any more, the EPROM must be cleared by an authorized service shop and be written into anew. Thus a calibration should only be made if necessary*

1.3.4 Option SM-B5 - FM/PM Modulator

The FM/PM modulator is fitted at the slot with label 'FMOD'.

Fitting the option

- ➢ Withdraw cable W89 from X99 of the summing loop and use again.
- ➢ Establish the following connections:

Cable	From	To	Signal
W89	A8-X89	A6-X67	FDSYN
W65	A6-X65	A7-X71	REF100
W67	A6-X69	A9-X99	FDFM

1.3.5 Option SMIQB20 - Modulation Coder

The Modulation Coder is fitted at the slot with label "MCOD".

➢ Plug the module into the appropriate place, lock it and fasten all screws

➢ Open the air inlets at the housing frame by breaking out the safety glass plate which belongs to the option

➢ Depending on the fact whether the option SMIQB14 (FSIM1) has been installed in the SMIQ, the following coaxial connections have to be made (cf. Fig. 1-2):

Note: *Please store the remaining cables. They will be required if further options will be installed at a later stage or options will be removed.*

		SMIQ without option FSIM 1		**SMIQ with option FSIM 1**		**Remark about cable**
Cable	**from MCOD**	**to**		**to**		
W322	X321	REFSS	X72	REFSS	X72	W322 was provided with MCOD.
W72	X322	DSYN	X81	DSYN	X81	Withdraw W72 from X72 of module REFSS.
W243	X323	BACK	POW RAMP socket	BACK	POW RAMP socket	Withdraw W243 from X243 of module IQMOD.
W324	X324	IQMOD	X243	IQMOD	X243	W324 was provided with MCOD.
W325	X325	IQMOD	X244		-	W325 was provided with MCOD.
W361	X325		-	FSIM 1	X361	W361 was provided with FSIM1.
	X326		-	-	-	-
W244	X327	FRO	I socket	FRO	I socket	Withdraw W244 from X244 of module IQMOD. If FSIM1 is installed withdraw W244 from X361 of module FSIM1.
W328	X328	IQMOD	X245		-	W328 was provided with MCOD.
W363	X328		-	FSIM 1	X363	W363 was provided with FSIM1.
	X329		-	-	-	-
W245	X330	FRO	Q socket	FRO	Q socket	Withdraw W245 from X245 of module IQMOD. If FSIM1 is installed withdraw W245 from X363 of module FSIM1.

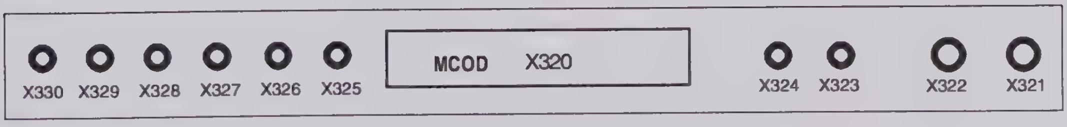


Fig. 1-2 Module MCOD

➢ The included adhesive label "Option included" is to be fixed at the rear panel of the SMIQ.

1.3.6 Option SMIQB11 - Data Generator

The Data Generator is fitted at the slot with label "DGEN".

- ➢ the module into the slot, lock it and fasten all screws
- ➢ Plug W341 onto X341
- ➢ Open the air inlets at the housing frame by breaking out the safety glass plate which belongs to the option.

1.3.7 Option SMIQB12 - Memory Extension to Data Generator

The Data Generator can be upgraded with up to two memory extension units (SMIQB12). The first Memory Extension is fitted at the slot with label "X350", the second Memory Extension at slot with label "X351".

- ➢ Remove option Data Generator from SMIQ.
- ➢ Withdraw the screws of the labelled screening cover and remove the cover.
- ➢ The first memory extension unit has to be pluged on connector X350 near the battery.
- ➢ The second memory extension unit has to be pluged on connector X351.
- ➢ Refit the screening cover of the Data Generator module.
- ➢ Plug the Data Generator back into the appropriate place, lock it and fasten all screws.

1.3.8 Option SMIQB14 - Fading Simulator FSIM1

The Fading Simulator is fitted at the slot with label 'FSIM1'.

Before fitting the option SMIQB14 (FSIM1) first check the correct settings of the jumpers on the module. For FSIM modules of series 1085.XXXX (see screening cover) the jumper setting also depends on the number of fading simulators installed, either one (FSIM1) or two (FSIM1 and FSIM2).

After an instrument warm-up period of 2 hours, the IQ Modulator should be calibrated.

Two coaxial connecting cables (Stock No. 1085.4448.00) are part of the equipment supplied with the option. The cables can be connected to the outputs I FADED and Q FADED at the rear of SMIQ.

Checking the jumper settings

Jumper Setting for the Fading Simulator FSIM1:
(Cf. labeling 'Jumper Setting' and labeling on the screening cover of the module)

FSIM1	**One Fading Simulator installed FADING SIMULATOR:** `1085.XXXX`			**Two Fading Simulators installed FADING SIMULATOR:** `1085.XXXX`			**FADING SIMULATOR:** `1114.XXXX`		
Jumper connects	X1.1	with	X1.2	X1.1	with	X1.2	X1.2	with	X1.3
	X8.1	with	X8.2	X8.2	with	X8.3	X8.1	with	X8.2
	X9.1	with	X9.2	X9.2	with	X9.3	X9.2	with	X9.3
	X12.2	with	X12.3	X12.2	with	X12.3	X12.2	with	X12.3
	X13.1	with	X13.2	X13.2	with	X13.3	X13.1	with	X13.2
	X15.1	with	X15.2	X15.1	with	X15.2	X15.1	with	X15.2
	X16.1	with	X16.2	X16.2	with	X16.3	none		

Fading modules of series 1114.XXXX also require the setting of a DIP switch. The setting is indicated on the screening cover.

	FADING SIMULATOR `1114.XXXX`	
Switch	1	2
FSIM1	OFF	ON

Fitting the option

- ➢ Plug the module into the appropriate slot, lock it and fasten all screws.
- ➢ Open the air inlets at the housing frame by breaking out the safety glass plate which belongs to the option.
- ➢ Depending on the fact whether the option SMIQB20 (MCOD) has been installed in the SMIQ, the following coaxial connections have to be made:

Note: Please store the remaining cables. They will be required if further options will be installed at a later stage or options will be removed.

		SMIQ with option MCOD	SMIQ without option MCOD	Remark about cable
Cable	from FSIM1	to	to	
W361	X361	MCOD X325	-	W361 was provided with FSIM1
W244	X361	-	FRO I socket	Withdraw W244 from X244 of module IQMOD
W363	X363	MCOD X328	-	W363 was provided with FSIM1
W245	X363	-	FRO Q socket	Withdraw W245 from X245 of module IQMOD
W367	X367	IQMOD X244	IQMOD X244	W367 was provided with FSIM1
W388	X368	REAR I FADED	REAR I FADED	W388 was provided with FSIM1
W370	X370	IQMOD X245	IQMOD X245	W370 was provided with FSIM1
W391	X371	REAR Q FADED	REAR Q FADED	W391 was provided with FSIM1

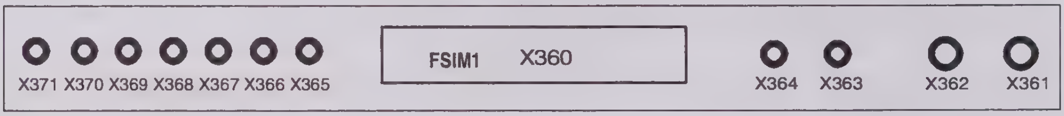


Fig. 1-3 Module FSIM

- ➢ The included adhesive label 'Option included' is to be fixed at the rear panel of the SMIQ.

Calibrating the Fading Simulator and the I/Q Modulator

- ➢ Warm-up the instrument for 2 hours.
- ➢ Call up menu UTILITIES - CALIB - VECTOR MOD.

1.3.9 Option SMIQB15 - Second Fading Simulator (FSIM2)

The second Fading Simulator is fitted at the slot with label 'FSIM2'.

Before fitting the option SMIQB15 (FSIM2) please check the correct settings of the jumpers on both fading modules FSIM1 (see Section 1.3.8) and FSIM2. The jumper settings depend on the series of the FSIM module, they are also indicated on the screening cover.

After an instrument warm-up period of 2 hours, the IQ Modulator should be calibrated.

Checking the jumper settings

Jumper Setting for the Fading Simulator FSIM2:
(cf. module number and labeling 'Jumper Setting' on the screening cover of the module)

FSIM2	FADING SIMULATOR `1085.XXXX`			FADING SIMULATOR `1114.XXXX`		
Jumper connects	X1.2	with	X1.3	X1.1	with	X1.2
	X8.2	with	X8.3	X8.2	with	X8.3
	X9.2	with	X9.3	X9.1	with	X9.2
	X12.1	with	X12.2	X12.1	with	X12.2
	X13.2	with	X13.3	X13.2	with	X13.3
	X15.2	with	X15.3	X15.2	with	X15.3
	X16.2	with	X16.3	none		

Fading modules of series 1114.XXXX also require the setting of a DIP switch. The setting is indicated on the screening cover.

	FADING SIMULATOR `1114.XXXX`	
Switch	1	2
FSIM1	OFF	ON
FSIM2	ON	OFF

Fitting the option

- ➢ Plug the module into the appropriate slot for the FSIM2, lock it and fasten all screws.
- ➢ Open the air inlets at the housing frame by breaking out the safety glass plate which belongs to the option.
- ➢ The following coaxial connections have to be made:

	FSIM2 Module number 1085.XXXX	FSIM2 Module number 1114.XXXX	FSIM1
Cable	from	from	to
W362	X361	X362	X362
W364	X363	X364	X364
W365	X365	X365	X365
W366	X367	X368	X366
W369	X370	X371	X369

Note: *Please store the remaining cables. They will be required if further options will be installed at a later stage or options will be removed.*

- ➢ The included adhesive label 'Option included' is to be fixed at the rear panel of the SMIQ.

Calibrating the Fading Simulator and the I/Q Modulators

- ➢ Warm-up the instrument for 2 hours.
- ➢ Call up menu UTILITIES - CALIB - VECTOR MOD.

Retrofit for 2-channel fading

Cables W388 and W391 have to be repositioned for 2-channel fading.

- ➢ Unplug W388 from X368 of FSIM1 and plug to X368 (1085.XXXX) or X367 (1114.XXXX) of FSIM2.
- ➢ Unplug W391 from X371 of FSIM1 and plug to X371 (1085.XXXX) or X370 (1114.XXXX) of FSIM2.

1.3.10 Option SMIQB17 - Noise Generator and Distortion Simulator

Depending on which options are fitted, the NDSIM module is mounted in the slot labelled FSIM1/FMOD/NDSIM or FSIM2/FMOD/NDSIM or E6GHZ/FMOD/NDSIM (in older units slot FSIM1/FMOD or FSIM2/FMOD).

After an instrument warm-up period of 1 hour, the NDSIM as well as the IQ Modulator should be calibrated. Then the instrument is ready for use.

Six coaxial connecting cables (W601, W602, W603, W388, W605, W391 and the adhesive option label are part of the equipment supplied with the option.

Fitting the option

- Plug the module into the appropriate slot.
- Lock it and fasten all screws.
- Open the air inlets at the housing frame by breaking out the safety glass plate which belongs to the option.
- If options FSIM1 and FSIM2 are fitted, cables W388 and W391 have to be connected as shown in Fig. 1-4.
- Depending on which modules are installed in the SMIQ, the following coaxial connections are to be made:

		SMIQ **without option MCOD** **without option FSIM1** **without option FSIM2**		**SMIQ** **with option MCOD** **without option FSIM1** **without option FSIM2**		**Remark about cable**
Cable	**from NDSIM**	**to**		**to**		
W244	X601	FRO	I-connector	-		Cable was provided with unit
W245	X602	FRO	Q-connector	-		Cable was provided with unit
W601	X601	-		MCOD	X325	W601 was provided with NDSIM
W602	X602	-		MCOD	X328	W602 was provided with NDSIM
W603	X603	IQMOD	X244	IQMOD	X244	W603 was provided with NDSIM
W388	X604	REAR	I FADED	REAR	I FADED	W388 was provided with NDSIM
W605	X605	IQMOD	X245	IQMOD	X245	W605 was provided with NDSIM
W391	X606	REAR	Q FADED	REAR	Q FADED	W391 was provided with NDSIM

		SMIQ **with option MCOD** **with option FSIM1** **without option FSIM2**		**SMIQ** **with option MCOD** **with option FSIM1** **with option FSIM2**		**Remark about cable**
Cabel	**from NDSIM**	**to**		**to**		
W601	X601	FSIM1	X367	FSIM1	X367	W601 was provided with NDSIM
W602	X602	FSIM1	X370	FSIM1	X370	W602 was provided with NDSIM
W603	X603	IQMOD	X244	IQMOD	X244	W603 was provided with NDSIM
W388	X604	REAR	I FADED	REAR	I FADED	W388 was provided with NDSIM
W605	X605	IQMOD	X245	IQMOD	X245	W605 was provided with NDSIM
W391	X606	REAR	Q FADED	REAR	Q FADED	W391 was provided with NDSIM

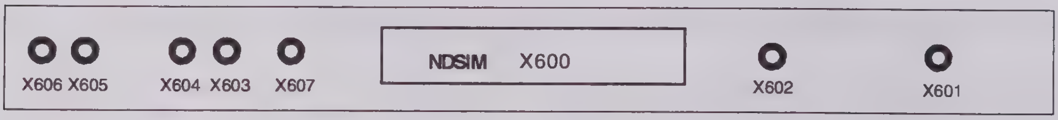


Fig. 1-4 Module NDSIM

Connector X607 is unused and provided only in some modules.

- ➢ The included adhesive label 'Option included' is to be fixed at the rear panel of the SMIQ.

Calibrating the NDSIM and the I/Q Modulator

- ➢ Warm-up the instrument for 1 hours.
- ➢ Call up menu UTILITIES - CALIB - VECTOR MOD.

1.3.11 Option SMIQB42 - Digital Standard IS-95 CDMA

Option SMIQB42 is a software options. It can be enabled by a keyword. The keyword is printed on a label which is part of the equipment supplied and into the groof below the handle of SMIQ.
A prerequisite for installing the option is that option SMIQB20 (Modulation Coder) and SMIQB11 (Data Generator) are part of SMIQ.

Enabling option

- ➢ Call up menu UTILITIES-INSTALL and then press key [SELECT].
- ➢ Select OPTION TO INSTALL and then press key [SELECT].
- ➢ Select option to be installed and then press key [SELECT].
- ➢ Enter the 6-digit keyword into the entry field INSTALLATION KEY and then press [ENTER]
- ➢ Switch off unit and then switch on again.

After installation, the new option can be checked in the module list in menu UTILITIES-DIAG-CONFIG.

1.3.12 Option SMIQB43 – Digital Standard W-CDMA

Option SMIQB43 is a software option. It can be enabled by a keyword. The keyword is printed on a label which is part of the equipment supplied and affixed into the groof below the handle of SMIQ.
A prerequisite for installing the option is that option SMIQB20 (Modulation Coder) and SMIQB11 (Data Generator) are part of SMIQ.

Enabling option

- ➢ Call up menu UTILITIES-INSTALL and then press key [SELECT].
- ➢ Select OPTION TO INSTALL and then press key [SELECT].
- ➢ Select option to be installed and then press key [SELECT].
- ➢ Enter the 6-digit keyword into the entry field INSTALLATION KEY and then press [ENTER].
- ➢ Switch off unit and then switch on again.

After installation, the new option can be checked in the module list in menu UTILITIES-DIAG-CONFIG.

1.3.13 Option SMIQB45 – Digital Standard 3 GPP W-CDMA

Option SMIQB45 is a software option. It can be enabled by a keyword. The keyword is printed on a label which is part of the equipment supplied and affixed into the groof below the handle of SMIQ.
A prerequisite for installing the option is that option SMIQB20 (Modulation Coder) and SMIQB11 (Data Generator) are part of SMIQ.

Enabling option

- ➢ Call up menu UTILITIES-INSTALL and then press key [SELECT].
- ➢ Select OPTION TO INSTALL and then press key [SELECT].
- ➢ Select option to be installed and then press key [SELECT].
- ➢ Enter the 6-digit keyword into the entry field INSTALLATION KEY and then press [ENTER].
- ➢ Switch off unit and then switch on again.

After installation, the new option can be checked in the module list in menu UTILITIES-DIAG-CONFIG.

1.3.14 Option SMIQB47 - LOW ACP Filter

Option SMIQB47 is a software options. It can be enabled by a keyword. The keyword is printed on a label which is part of the equipment supplied and into the groof below the handle of SMIQ.

Enabling option

- ➢ Call up menu UTILITIES-INSTALL and then press key [SELECT].
- ➢ Select OPTION TO INSTALL and then press key [SELECT].
- ➢ Select option to be installed and then press key [SELECT].
- ➢ Enter the 6-digit keyword into the entry field INSTALLATION KEY and then press [ENTER]
- ➢ Switch off unit and then switch on again.

After installation, the new option can be checked in the module list in menu UTILITIES-DIAG-CONFIG.

1.3.15 Option SMIQB19 - Rear Panel Connections for RF and LF

The SMIQ can be retrofitted to include rear panel connections for RF and LF for mounting it into a 19" rack using option SME-B19. The mounting instructions are attached to the option.

1.4 Mounting into a 19" Rack

Caution: *Ensure free air inlet at the perforation of the side walls and air outlet at the rear of the instrument in rack mounting.*

The SMIQ can be mounted into a 19" rack by means of rack adapter ZZA-94 (stock no. 396.4905.00).
The mounting instructions are attached to the adapter.

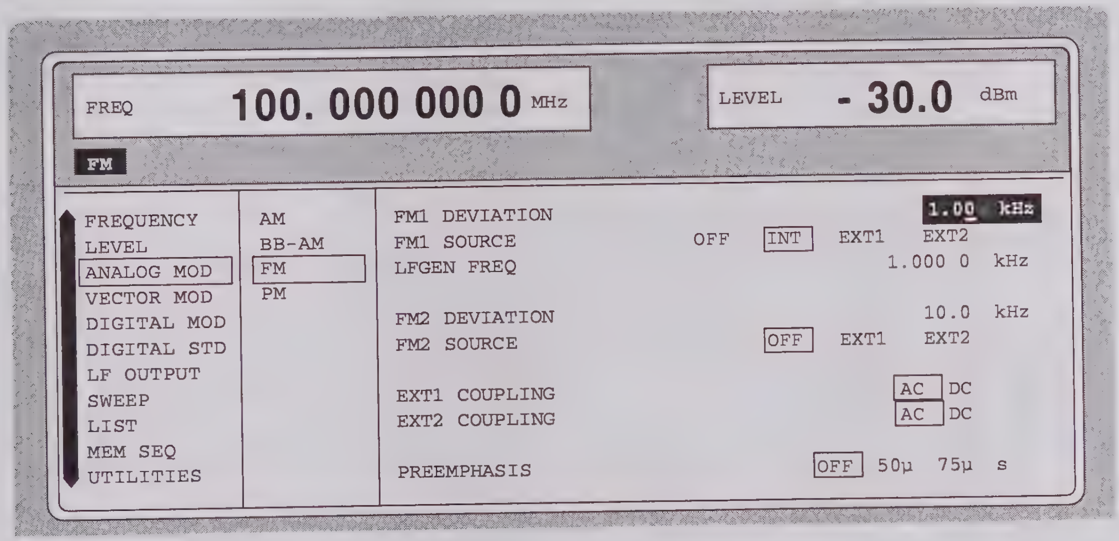
2 Operation

2.1 Front and Rear Panel

2.1.1 Display

(cf. Fig. 2-1, Front panel view)

1



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

FM1 DEVIATION 1.00 kHz

FM1 SOURCE OFF INT EXT1 EXT2

LFGEN FREQ 1.000 0 kHz

FM2 DEVIATION 10.0 kHz

FM2 SOURCE OFF EXT1 EXT2

EXT1 COUPLING AC DC

EXT2 COUPLING AC DC

PREEMPHASIS OFF 50µ 75µ s

The display shows in the

header field:
- the current frequency and level settings (considering an offset).
- status messages.
- error messages.

menu field:
- the main menu and the submenus selected with the current settings.

Parameters can be selected and changed in the menus indicated.

see as well Chapter 2, Section "Design of the Display"

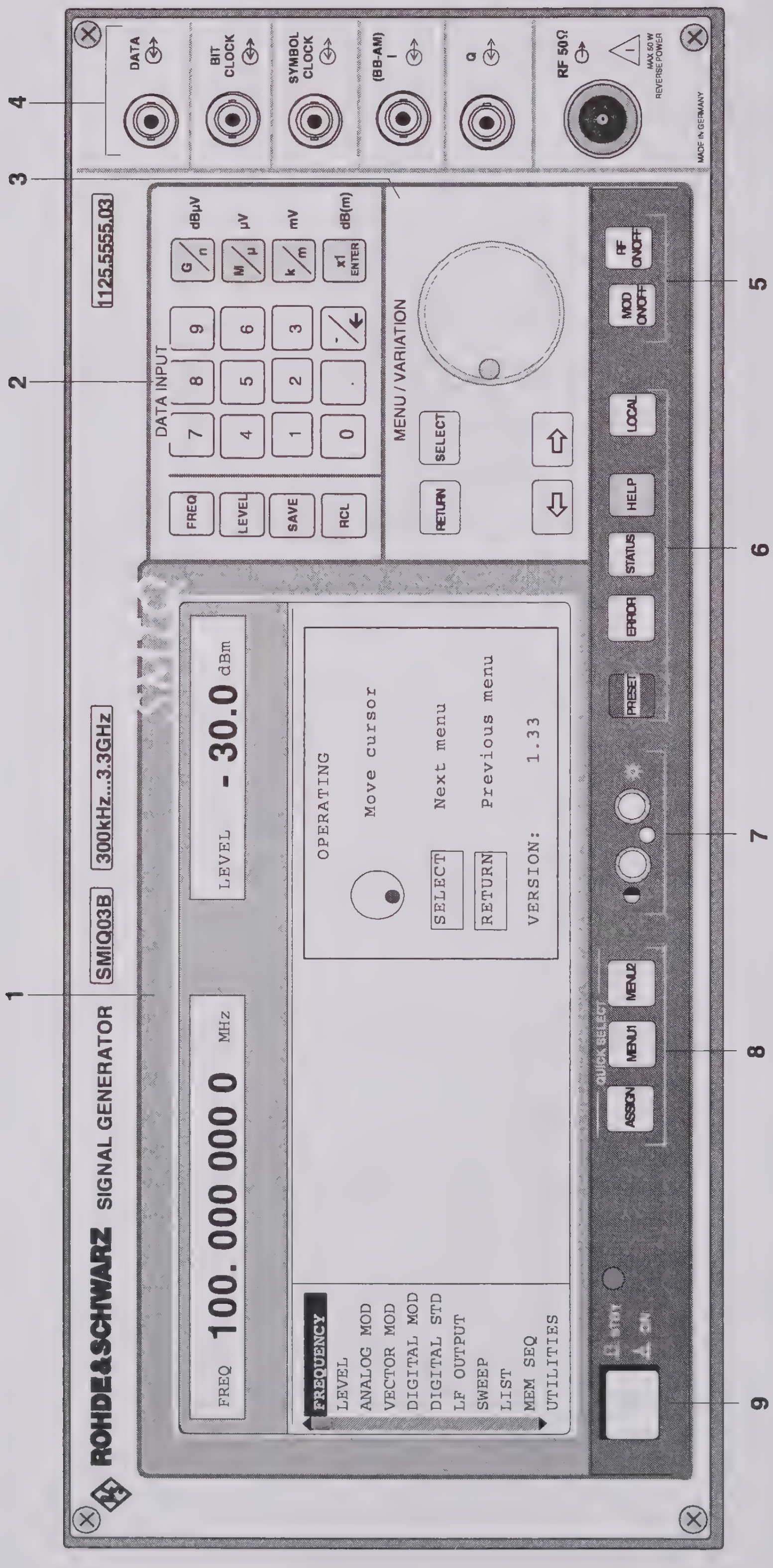


Fig. 2-1 Front panel view

2.1.2 Controls and Inputs/Outputs of the Front Panel

(cf. Fig. 2-1, front panel view)

2 DATA INPUT

Parameter field

Parameters RF frequency and RF level can be entered directly by means of the parameter keys, alternatively to menu operation. The input value (indicated in the header field) considers the offset, see Sections 2.4 and 2.5. Further, complete instrument settings can be stored and called.

FREQ	Opens the setting of the RF frequency via value input or variation by means of a rotary knob. The current menu is maintained. Return to the menu by means of the [RETURN] key. (Setting of the RF frequency also in the FREQUENCY menu).
LEVEL	Opens the setting of the RF level via value input or variation by means of a rotary knob. The current menu is maintained. Return to the menu by means of the [RETURN] key. (Setting of the RF level also in the LEVEL menu).
SAVE	Opens the storing of the current instrument setting. Memory selection is effected by entering a number (1 to 50) and is finished by means of the [ENTER] key.
RCL	Opens the calling of an instrument setting stored. Memory selection is effected by entering a number (1 to 50) and is finished by means of the [ENTER] key.

see as well
Chapter 2
Section
"Use of [FREQ] and [LEVEL] Keys"

Section
"RF Frequency"

Section
"RF Level"

Section
"Storing and Calling of Instrument Settings"

Numeric input field

Numeric values, decimal point and minus sign can be entered by means of the digital keys.,

0...9	Enters the digit.
•	Enters the decimal point
-/←	Enters the minus sign. Deletes the last input (digit, sign or decimal point) - key [BACKSPACE].

see as well
Chapter 2
Section
"Basic Operating Steps"

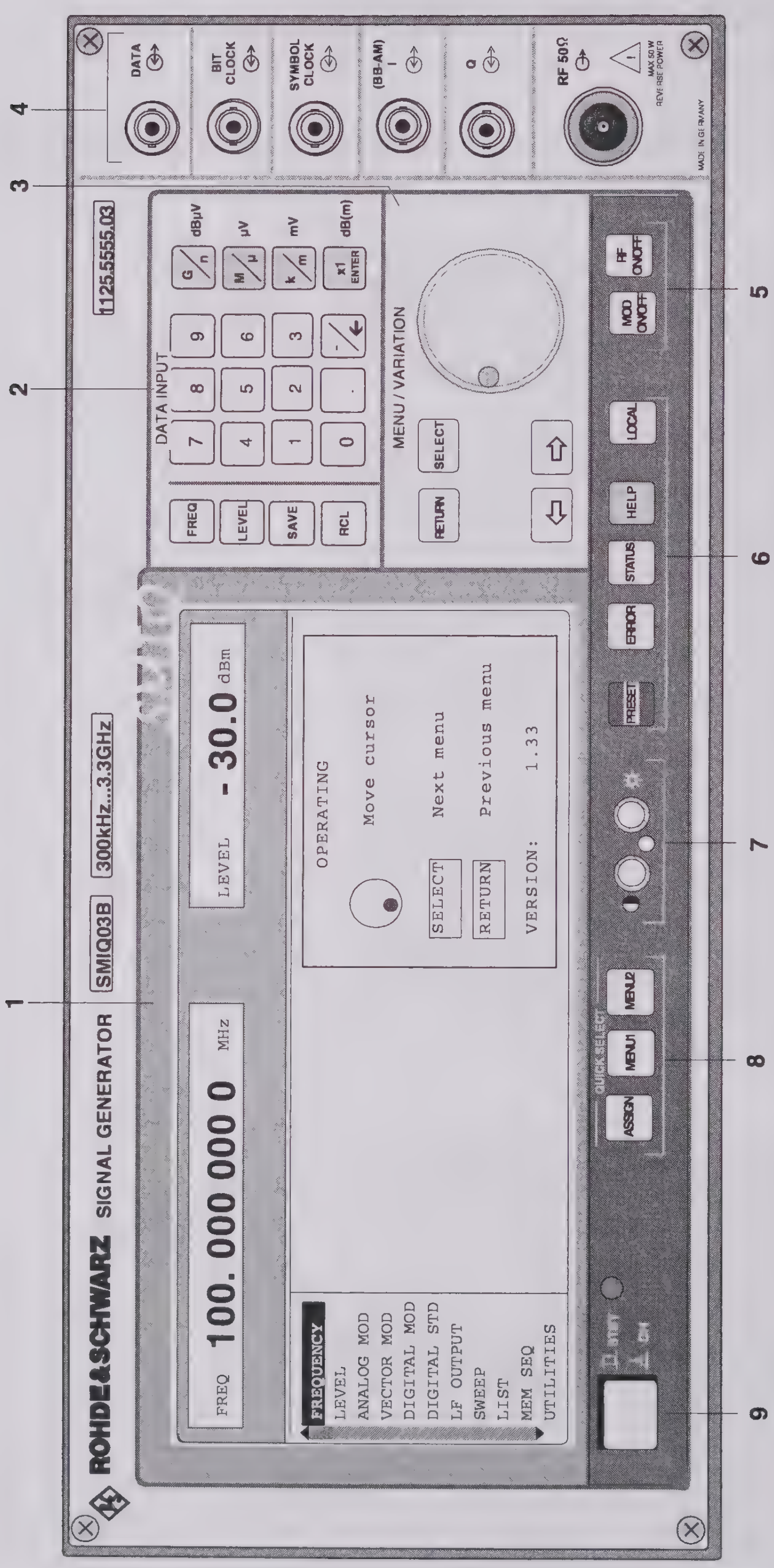
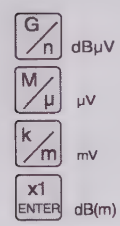


Fig. 2-1 Front panel view

2 DATA INPUT

Unit keys with enter function



The unit keys terminate the input of values and specify the multiplication factor for the respective basic unit. The basic units are displayed next to the input field while numbers are entered. In the case of level settings, the unit keys specify the unit.

G/n	dBμV	Selects giga/nano, with RF level dBμV, with LF level dBu.
M/μ	μV	Selects mega/micro, with level μV.
k/m	MV	Selects kilo/milli, with level mV.
1x Enter	dB(m)	Terminates entries in the basic unit and value inputs without unit. Selects with level dBm Selects with level offset and level step width dB.

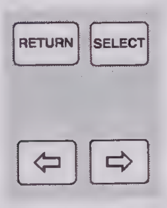
In order to change to another level unit, simply press the unit key desired. Parameter LEVEL must be activated, e.g. by pressing the [LEVEL] key.

see as well
Chapter 2
Section
"Basic Operating Steps"

Section
"Change Unit of Level"

3 MENU/VARIATION

Menu keys



The menu keys access the menus and settings within the menus.

RETURN	Returns the menu cursor to the next higher menu level.
SELECT	Acknowledges the choice marked by the menu cursor
⇐	Moves the digit cursor to the left by one position in the marked value indication. Moves the menu cursor to the left by one position in a 1-out-of-n selection.
⇒	Moves the digit cursor to the right by one position in the marked value indication. Moves the menu cursor to the right by one position in a 1-out-of-n selection.

see as well
Chapter 2
Section
"Basic Operating Steps"

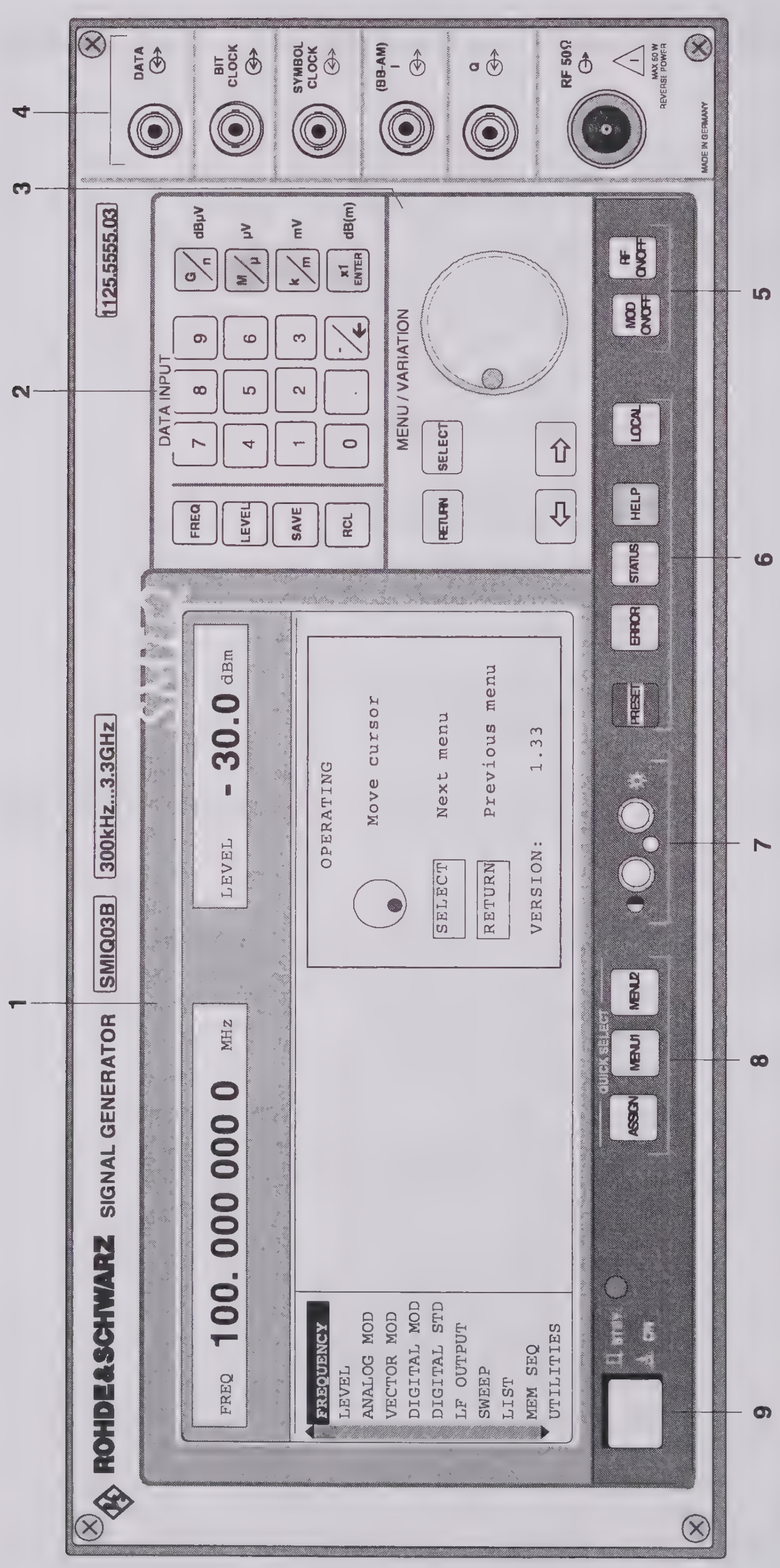
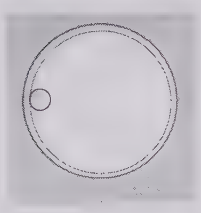


Fig. 2-1 Front panel view

3 MENU/VARIATION

Rotary knob



The rotary knob moves the menu cursor over the positions of a menu level to choose from or varies the value of a parameter. The variation is either effected in steps of one or in a step width that can be specified at will.

See as well Chapter 2 Section "Basic Operating Steps"

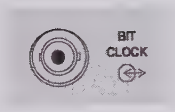
Section "Sample Setting for First Users"

4

DATA

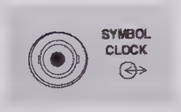
Input external data signal for digital modulation. Input resistance 1 kΩ or 50 Ω,
Trigger threshold can be set from -2.5 to + 2.5V, max. ± 15 V, max. 40 mA.
Output* data signal with operating mode internal. Level: TTL

See as well Chapter 2, Section "Digital Modulation"



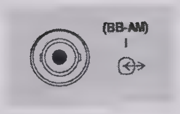
BIT CLOCK

Input* external clock-pulse signal for synchronization of external data signal.
Input resistance 1 kΩ or 50 Ω,
Trigger threshold can be set from -2.5 to + 2.5 V, max. ± 15 V, max. 40 mA.
Output* clock-pulse signal with operating mode internal. Level: TTL



SYMBOL CLOCK

Input* external clock signal for synchronization of the external data signal with polyvalent modulation types with several bits per symbol.
Input resistance 1 kΩ or 50 Ω,
Trigger threshold can be set from -2.5 to + 2.5V, max. ± 15 V, max. 40 mA.
Output* symbol clock signal with operating mode internal. Level TTL



(BB-AM) I

Input external modulation signal for I/Q modulation and broadband-AM.
Output* I-signal with operating mode internal.
Input/output resistance 50 Ω.
Nominal voltage (I/Q): $U_S = 0.5$ V
Nominal voltage (BB-AM): $U_S = 0.25$V
max. permissible overvoltage: ± 5V

Section "Vector Modulation" and Section "Broadband AM"

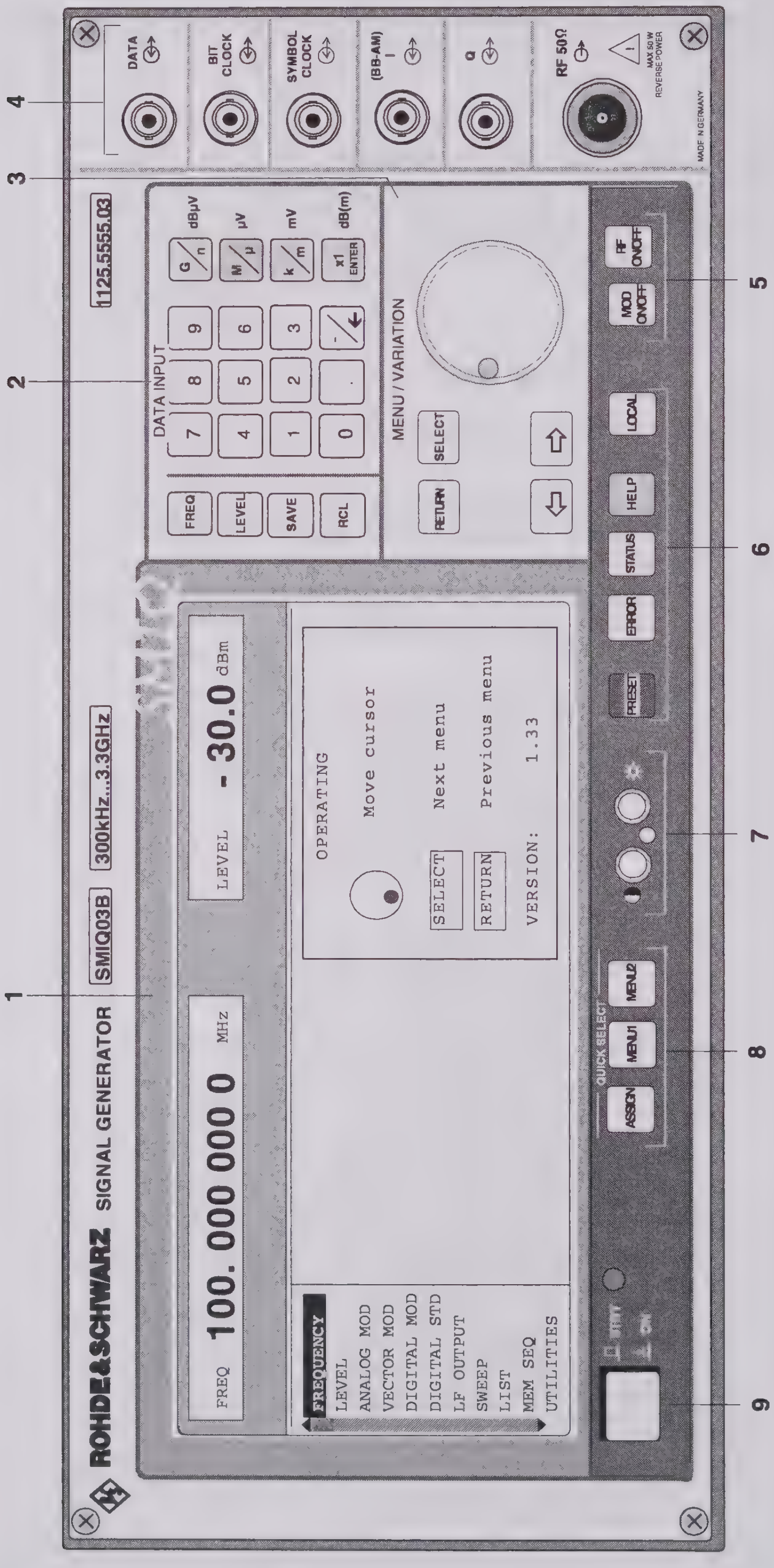


Fig. 2-1 Front panel view

4

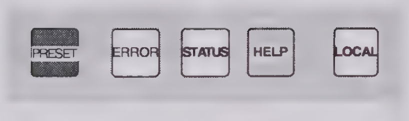
Q	Input external modulation signal for I/Q modulation. Output* Q-signal with operating mode internal. Input/output resistance 50 Ω. Nominal voltage: U_S = 0.5 V max. permissible overvoltage: ± 5V	Section "Vector Modulation"
RF	Output RF signal. Source resistance 50 Ω max. permissible HF-power: 50 W max. permissible overvoltage: 35 V	Section "Use of [ON/OFF] and [MOD ON/OFF] Key"

* When fitted with option Modulation coder, SMIQB20

5

MOD ON/OFF	Switches on/off the modulation selected in the UTILITIES MOD KEY menu.	See as well Chapter 2 Section "Use of [RF ON/OFF] and [MOD ON/OFF] Keys"
RF ON/OFF	Switches on/off the RF signal.	

6



PRESET	Establishes a defined instrument status.	See as well Chapter 1 Section "Preset Setting" Chapter 2 Section "Help System" Section "Status" Section "Error Messages" Chapter 3, "Remote Control"
ERROR*	Indicates error and caution messages.	
STATUS*	Indicates the instrument status.	
HELP*	Indicates context-sensitive auxiliary text.	
LOCAL	Switches the instrument from the REMOTE mode (remote control) to the LOCAL mode (manual control).	

* Exit the menus using the [RETURN] key.

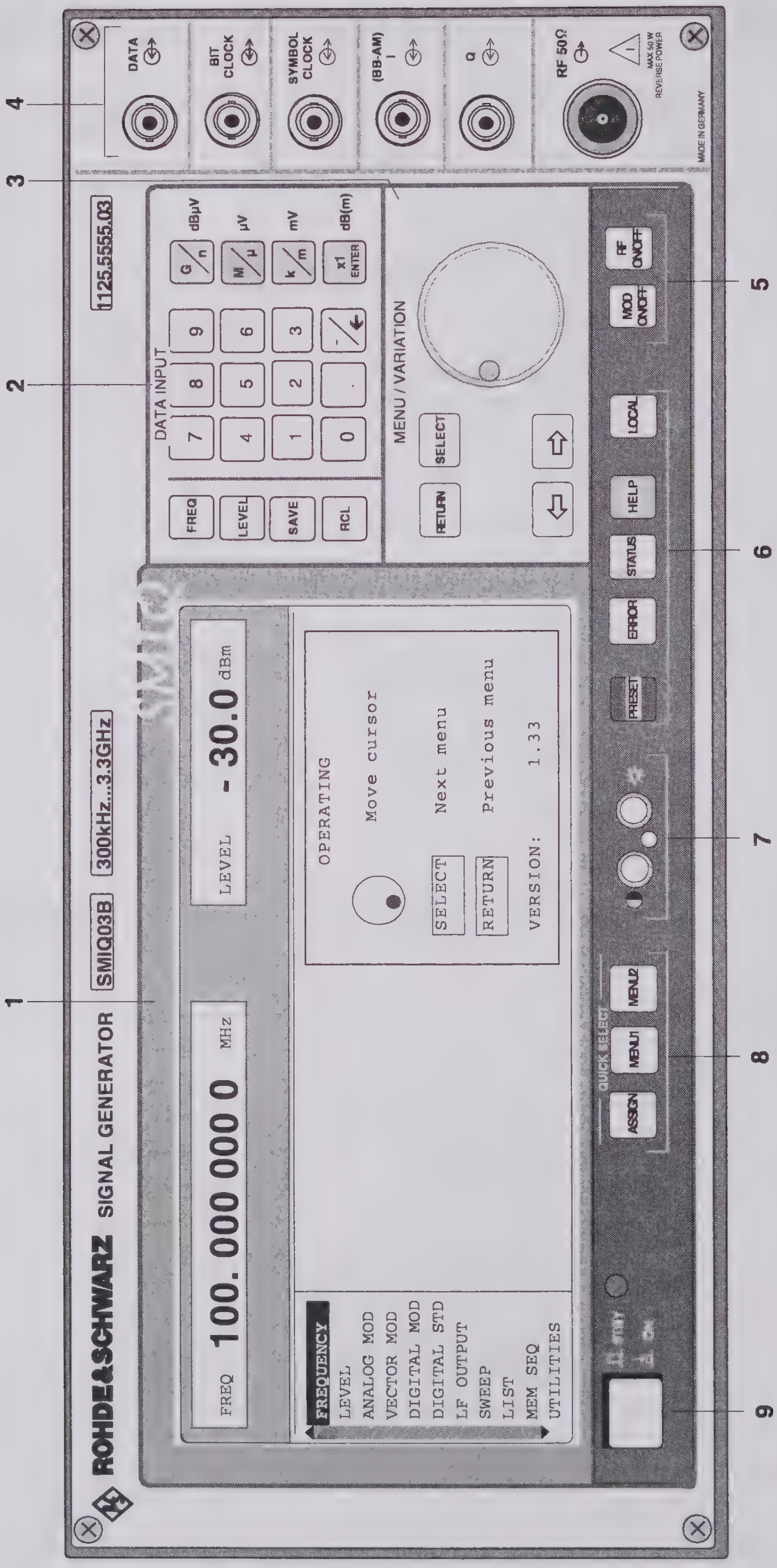
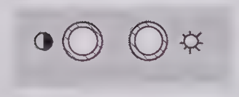


Fig. 2-1 Front panel view

7

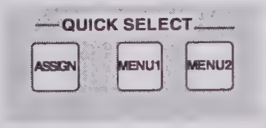


Brightness and contrast of the display can be set using the rotary knobs.

◑	Contrast
☼	Brightness

See as well
Chapter 1
Section "Setting of Contrast and Brightness of the Display"

8 QUICK SELECT

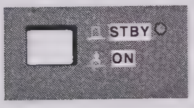


The menu-quick-selection keys permit fast access to two menus selected.

ASSIGN	Stores the current menu as menu1 when the MENU1 key is pressed afterwards or as menu2 when the MENU2 key is pressed afterwards.
MENU1	Activates menu1 stored.
MENU2	Activates menu2 stored.

See as well
Chapter 2
Section
"Basic Operating Steps"

9 Switching On/Off



The On/Off switch switches the instrument from the standby mode to the ready-for-operation status. Prerequisite: The power switch at the rear of the instrument must be switched on.

STBY	LED is illuminated in the standby mode.

see as well
Chapter 1
Section "Switching On/Off the Instrument"

Chapter 2
Section "Elements of the Rear Panel, Power Switch"

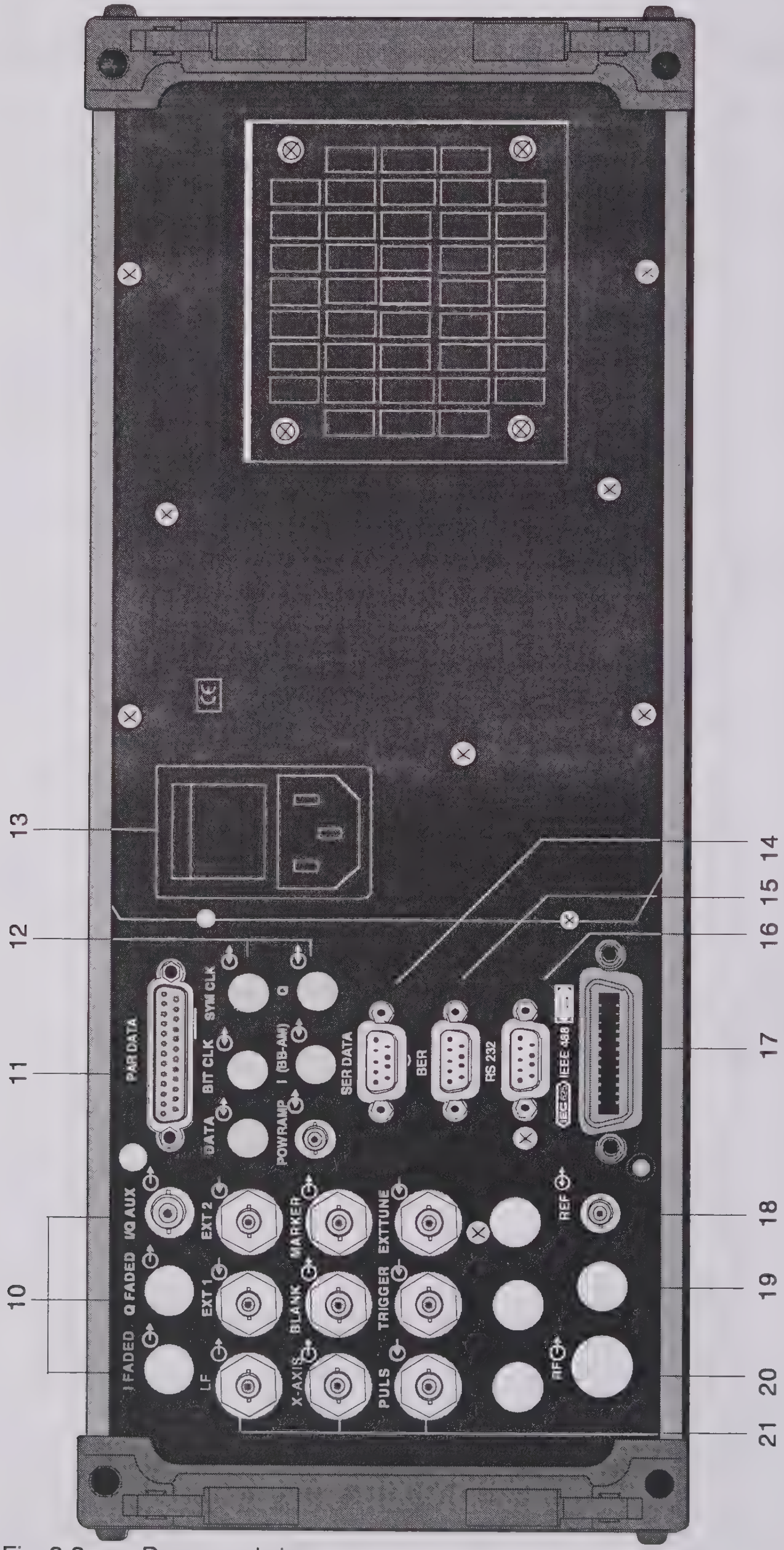


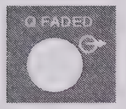
Fig. 2-2 Rear panel view

2.1.3 Elements of the Rear Panel

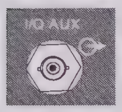
(Cf. Fig. 2-2, Rear panel view)

10

I FADED — Faded I signal.



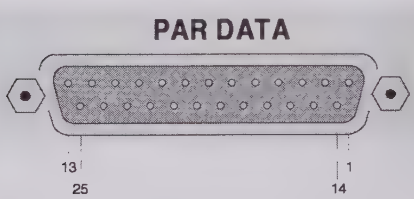
Q FADED — Faded Q signal.



IQ AUX — Output I/Q modulated subcarrier. Frequency 300 MHz, level -5 dBm, source resistance 50Ω

see as well Chapter 2, "Fading Simulation"

11



An adapter between the PAR DATA connector and coaxial BNC connectors is available as an accessory (SMIQ-Z5, order no. 1104.8555.02).

PAR DATA

Pin	Description
1 - ⊥ 2 - ⊥	Ground Ground
3 - DATA-D6 4 - DATA-D4 5 - DATA-D2 6 - DATA-D0	Parallel data input/output D0 to D6 for digital modulation. Output: TTL signal. Input: Input resistance 1kΩ or 50Ω. Trigger threshold can be set from -2.5 to 2.5V, max. ± 15V, max. 40 mA
7 - SYMBCLK	Symbol clock input/output for synchronization of the data signal with modulation types with several bits per symbol. Output: TTL signal. Input: Input resistance 1kΩ or 50Ω. Trigger threshold can be set from -2.5 to 2.5V, max. ± 15V, max. 40 mA

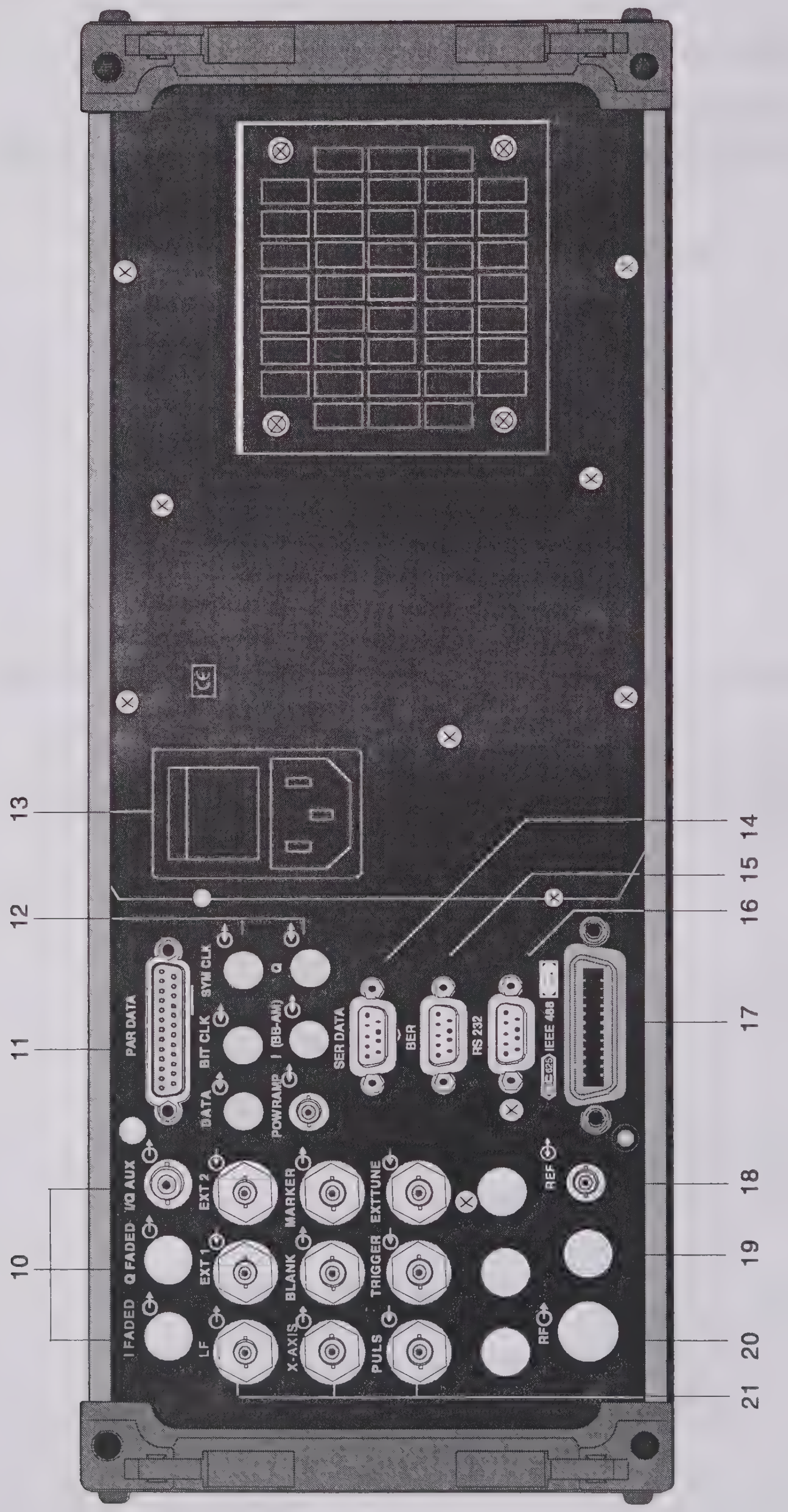


Fig. 2-2 Rear panel view

11

PAR DATA

Pin	Description
8 - ⊥	Ground
9 - LEV-ATT	Signal input/output for controlling of level reduction. Output: TTL signal. Input: Input resistance 1kΩ or 50Ω. Trigger threshold can be set from -2.5 to 2.5V, max. ± 15V, max. 40 mA
10 - ⊥	Ground
11 - TRIGOUT 1	Output for triggering of external instruments. Output: TTL signal.
12 - ⊥	Ground
13 - ⊥	Ground
14 - TRIGIN	Input for triggering of frames, PRBS and data sequences. Input: Input resistance 1kΩ or 50Ω. Trigger threshold can be set from -2.5 to 2.5V, max. ± 15V, max. 40 mA
15 - DATA-D7 16 - DATA-D5 17 - DATA-D3 18 - DATA-D1	Parallel data input/output D1to D7 see pin 3 - 6
19 - ⊥	Ground
20 - BITCLK	Output bit clock with operating mode internal. TTL signal
21 - CW	Signal input/output for controlling of modulation. Switches carrier to CW with FSK modulation. Output: TTL signal. Input: input resistance 1kΩ or 50Ω. Trigger threshold can be set from -2.5 to 2.5V, max. ± 15V, max. 40 mA
22 - BURST-GATE	Signal input/output for controlling of the burst profile. Output: TTL signal. Input: input resistance 1kΩ or 50Ω. Trigger threshold can be set from -2.5 to 2.5V, max. ± 15V, max. 40 mA
23 - TRIGOUT 2	Output for triggering and controlling of external instruments. Output: TTL signal.
24 - TRIGOUT 3	Output for triggering and controlling of external instruments. Output: TTL signal.
25 - HOP	HOP output provides control signal when internal frequency hopping is programmed. Output: TTL signal

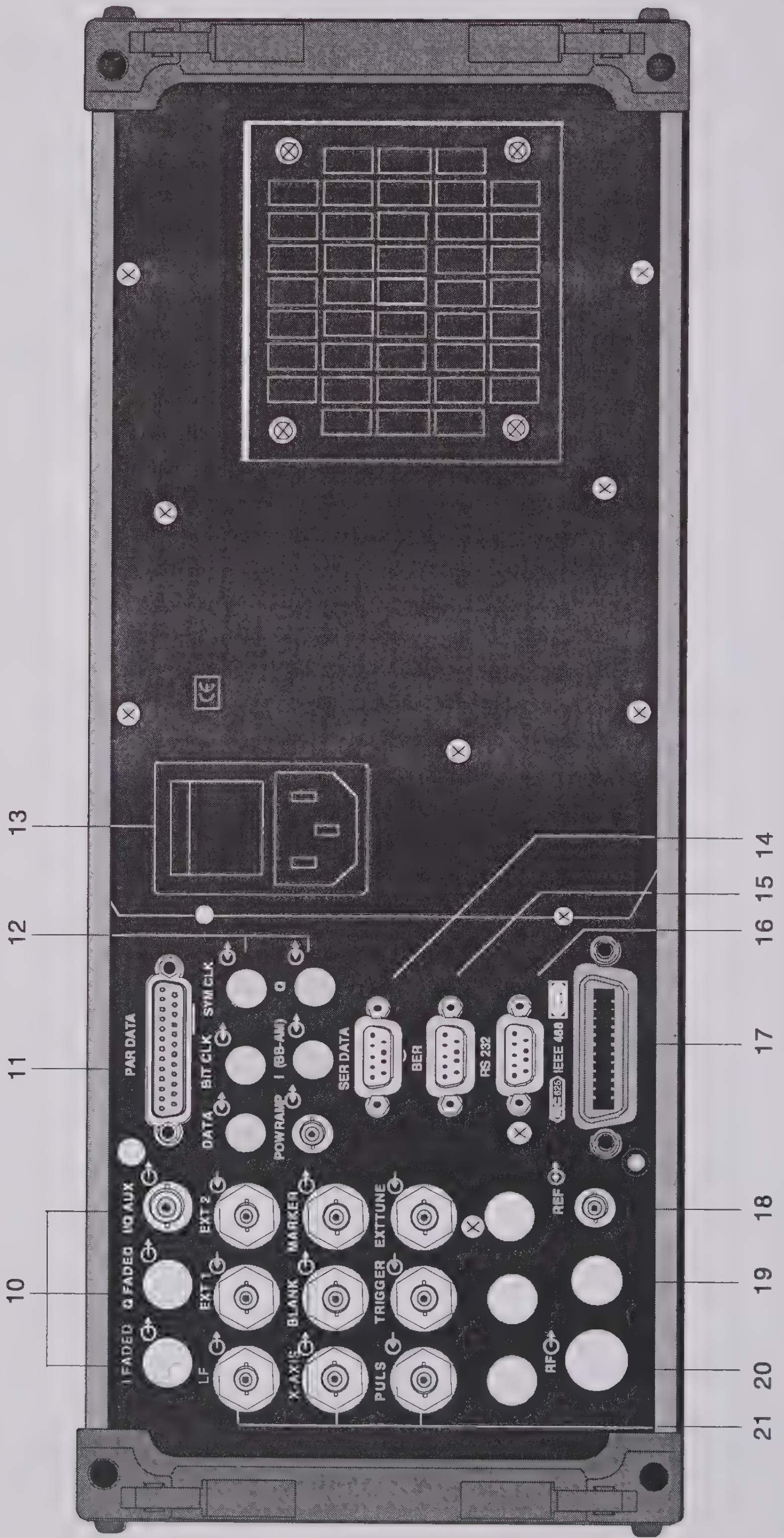
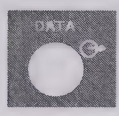
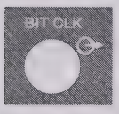


Fig. 2-2 Rear panel view

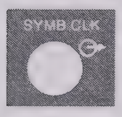
12



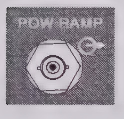
DATA Cut-out, provided to relocate the DATA input/output at the front to the rear of the instrument.



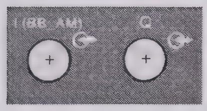
BIT CLK Cut-out, provided to relocate the BIT CLK input/output at the front to the rear of the instrument.



SYMB CLK Cut-out, provided to relocate the SYMB CLK input/output at the front to the rear of the instrument.



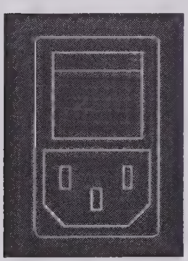
POW RAMP Signal input/output for power ramping.
Input: accepts analog voltages from 0 to 1 V for envelope modulation.
Input resistance 10kΩ
Max. permissible overvoltage ±15 V
Output provides modulation voltage of burst envelope with internal modulation.
output resistance 10Ω
Max. permissible overvoltage ±15 V



I (BB-AM) Cut-out, provided to relocate the I- input at the front to the rear of the instrument.

Q Cut-out, provided to relocate the Q- input at the front to the rear of the instrument.

13



Power switch
ON when pressed at the top ("I")

Power supply connection

see as well
Chapter 1,
Section
"Supply Voltage"
Section
"Switching On/Off the Instrument"

14

SER DATA Asynchronous data input for digital modulation.
Interface: RS232 up to 115 kbps

see as well
Annex A
"interfaces"

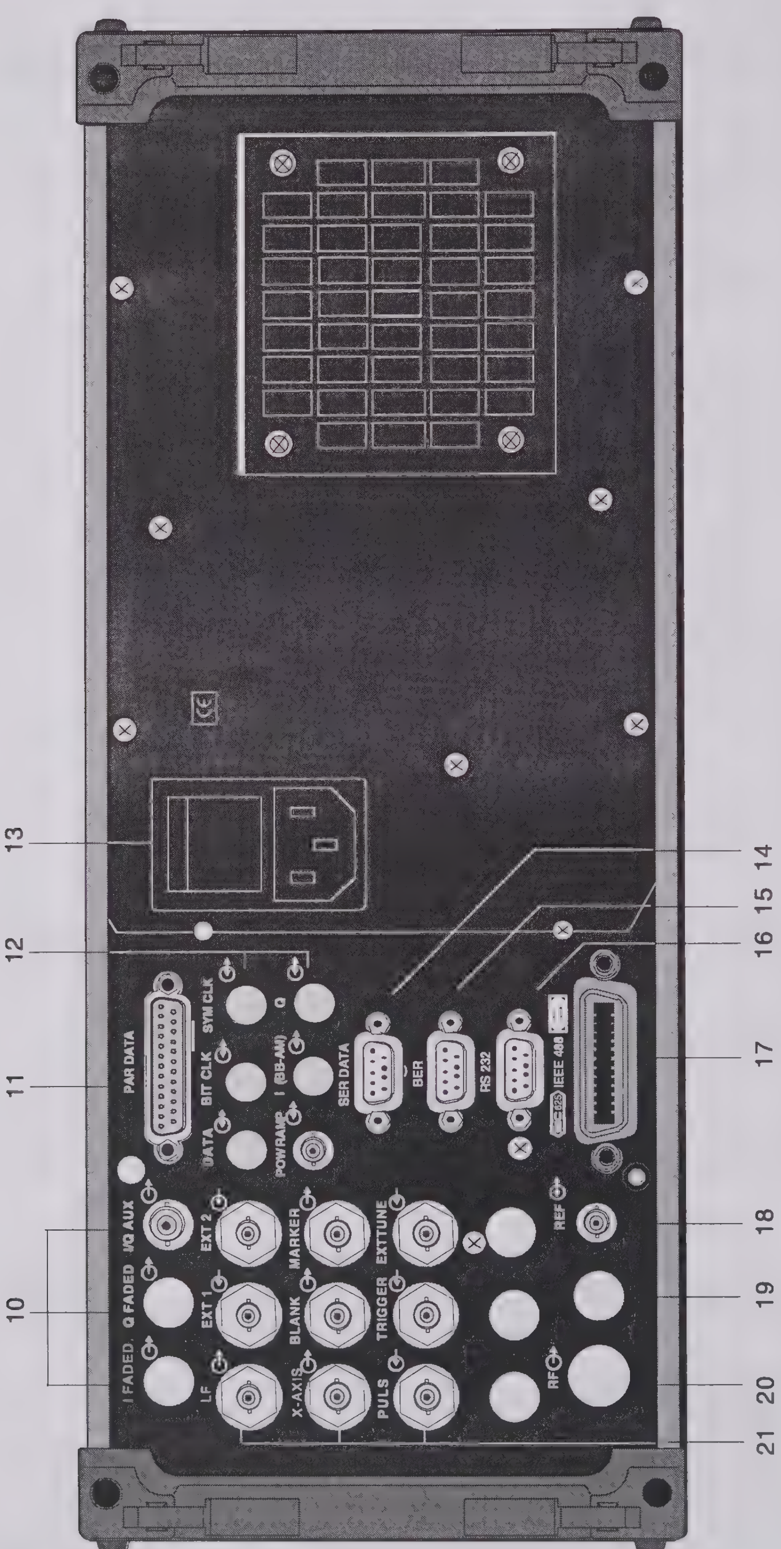
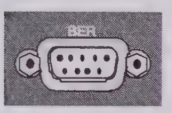


Fig. 2-2 Rear panel view

15



Interface for BER Measurement		See as well chapter 2, section "External Modulation Source AMIQ"

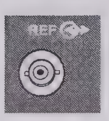
16

RS-232	RS-232 interface, used for software update, the loading of calibration data, and remote control. The pin assignment corresponds to the pin assignment of a PC.	see as well Chapter 3 Remote Control and Annex A "Interfaces"

17

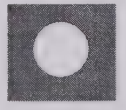
IEC 625 IEEE 488	IEC-Bus (IEEE 488) Remote-control interface	See as well Chapter 3, "Remote Control"

18



REF	Output of the internal 10-MHz reference signal with reference internal. Source resistance 50 Ω. Input for external reference frequency with reference external. Adjustable to external reference frequencies from 1 to 16 MHz in 1-MHz steps. Input resistance 200 Ω.	See as well Chapter 2, Section "Reference Frequency int/ext"

19



	4 optional cut-outs, provided for further connections	

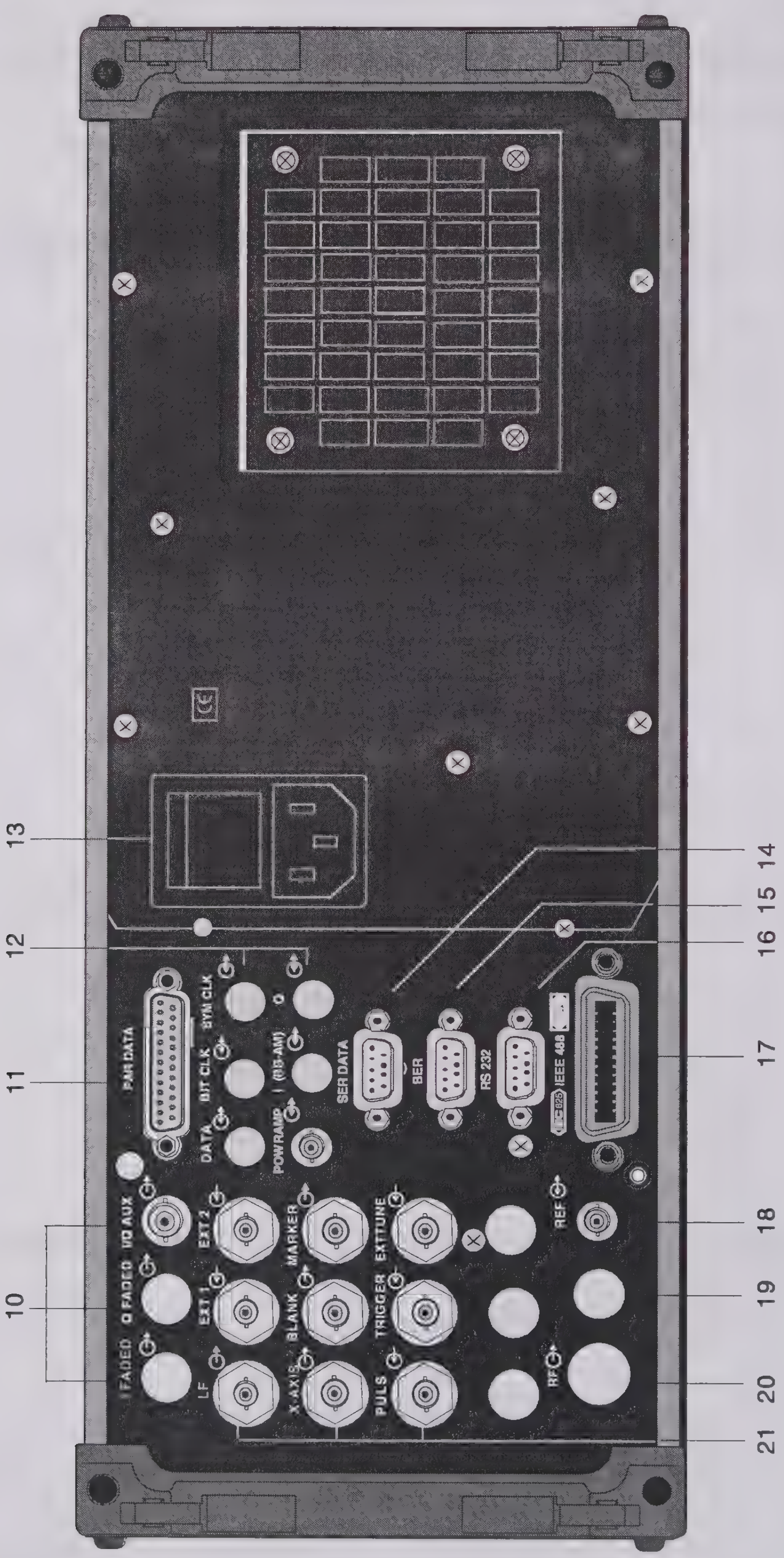
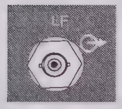
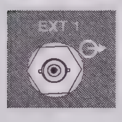
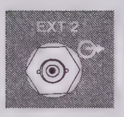
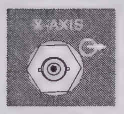
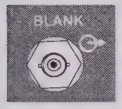
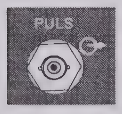
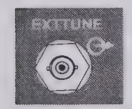


Fig. 2-2 Rear panel view

20

	RF	Cut-out, provided to relocate the RF output at the front to the rear of the instrument

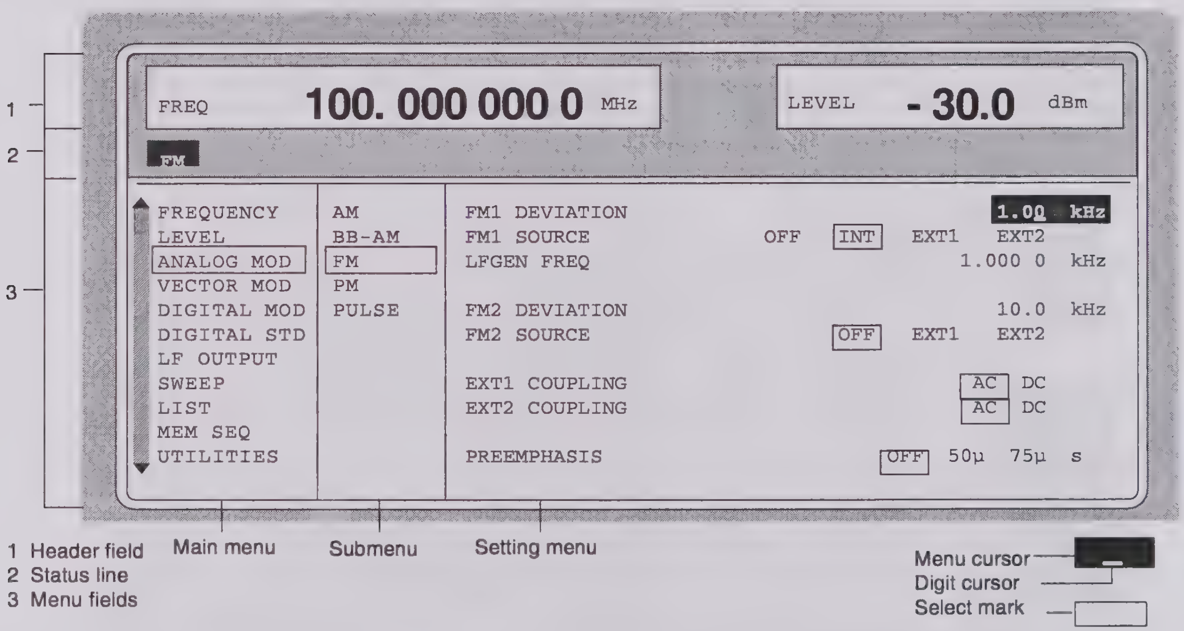
21

	LF	Output LF signal of the internal LF generator. Source resistance < 10 Ω.
	EXT1	Input external modulation signal, alternatively for AM or FM (PM). Input resistance >100 kΩ. Nominal voltage: $U_S = 1$ V Max. permissible overvoltage: ± 15 V
	EXT2	Input external modulation signal for FM (PM). Input resistance >100 kΩ. Nominal voltage: $U_S = 1$ V Max. permissible overvoltage: ± 15 V
	X-AXIS	Output supplies a voltage ramp of 0 to 10 V, when a sweep is switched on.
	BLANK	Output supplies a signal to blank the return sweep or the settling process in LIST mode Level: TTL
	MARKER	Output is active when the sweep reaches the marker or at the first step of the LIST mode. Level: TTL
	PULS	Input for pulse modulation. Level: TTL Input resistance 10Ω
	TRIGGER	Input to trigger sweep, LIST mode and Memory Sequence. Level: TTL
	EXTTUNE	Tuning input for the internal reference frequency. Voltage range ± 10 V, pulling range $\pm 1\cdot 10^{-6}$

2.2 Basic Operating Steps

The operating principle is explained in this section. For better understanding, please read section "Sample Setting for First Users" (Section 2.2.10) in addition.
To operate the instrument, menus are called in the display. All setting possibilities and the current setting status are evident from the menus. All settings can be made by accessing the menus.
RF frequency and RF level can also be set without menu operation using keys [FREQ] and [LEVEL]. RF signal and modulation can also be switched on/off without menu operation using keys [RF ON/OFF] and/or [MOD ON/OFF].

2.2.1 Design of the Display



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

FM1 DEVIATION 1.00 kHz

FM1 SOURCE OFF INT EXT1 EXT2

LFGEN FREQ 1.000 0 kHz

FM2 DEVIATION 10.0 kHz

FM2 SOURCE OFF EXT1 EXT2

EXT1 COUPLING AC DC

EXT2 COUPLING AC DC

PREEMPHASIS OFF 50µ 75µ s

Fig. 2-3 Design of the display

Header field (1)The header field of the display indicates frequency and level of the RF output signal which considers the offset value. In the RF-sweep operating mode, the start and stop frequencies are displayed in two lines one above the other. The start and stop levels are indicated in the LEVEL-sweep operating mode correspondingly. A two-line level display appears for digital modulation or digital standard. The upper line indicates the average power (LEVEL), the lower line the peak envelope power (PEP) of the modulated RF output signal.

Status line (2) The status line below describes operating mode and operating state of the instrument. Error messages and notes for caution are also displayed in the status line.

Menu fields (3)The indication fields below the header field are reserved for the menu representations. The image contents of these fields change as a function of the menu selected. The field at the left-hand display margin is occupied with the main menu, the topmost level of the menu structure. The main menu is always faded in.

Each further field adjacent at the right contains submenus.
The field ending with the right-hand display margin shows the setting menu. In this menu all setting values and setting states connected with the menu selected are indicated. When accessing submenus, the higher-order menus remain in the display. The current menu path is evident through the select marks.

Menu cursor	The menu cursor shows the user at which position in the menu he is. The position of the menu cursor is evident from the inverse notation of the term (white characters on a black background)
Digit cursor	As an underscore, the digit cursor marks the position which can be varied by means of the rotary knob in a value indication.
Select mark	The frame around a term marks current menus or valid settings in the setting menu.

2.2.2 Calling the Menus

Accessing the menus is effected using rotary knob [VARIATION], [SELECT] key and [RETURN] key.

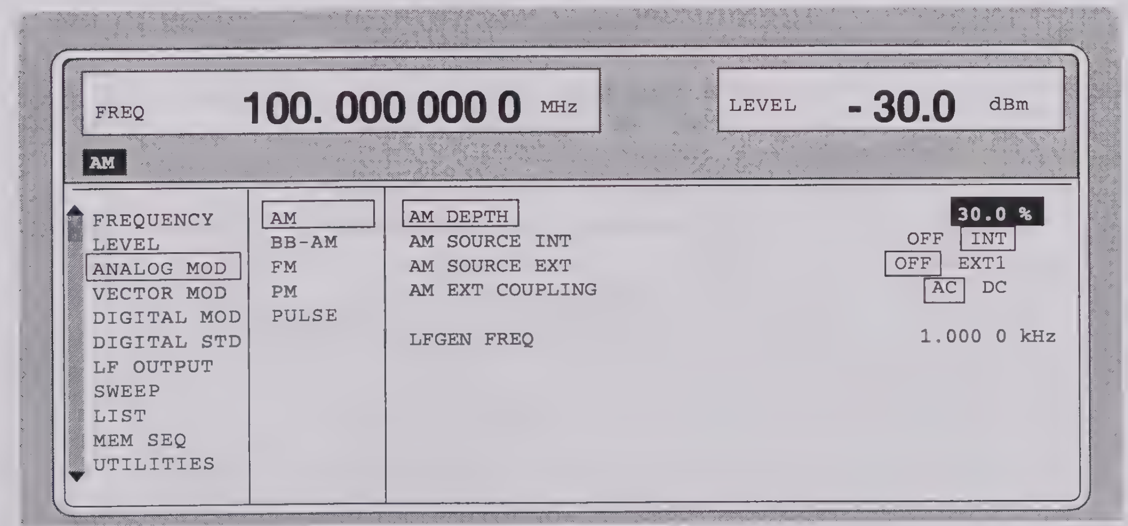
Rotary knob Rotary knob [VARIATION] moves the menu cursor over the positions of a menu level to be selected. If a scrollbar is visible at the left-hand margin of a menu, the menu is larger than the screen window. If the menu cursor is moved to the margin of the screen window, the covered lines become visible.

[SELECT] key The [SELECT acknowledges the selection marked by means of the menu cursor.

[RETURN] key The [RETURN] key

- returns the menu cursor to the next higher menu level. The menu cursor is shifted to the left into the preceding column of the menu structure.
- resets the menu cursor from frequency or level value indication in the header field into the menu field to the menu called last.
- closes the display pages called using keys [STATUS], [HELP] and [ERROR] again.

Settings are accessed in the setting menus ending with the right-hand display margin.



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

AM DEPTH 30.0 %
AM SOURCE INT OFF INT
AM SOURCE EXT OFF EXT1
AM EXT COUPLING AC DC
LFGEN FREQ 1.000 0 kHz

Fig. 2-4 MODULATION-AM menu

2.2.3 Selection and Change of Parameters

Select parameter

- Set the menu cursor to the name of the parameter desired using the rotary knob, e.g. to AM DEPTH in the AM menu, Fig. 2.4.

Change setting value

- Via value input or using rotary knob.

via value inputs

- Press the first digit of the new value or minus sign.
  The old value is deleted, the entry is indicated in the marked field.
- Enter further digits.
- Terminate the input using a unit key or, in the case of inputs in the base unit or in the case of inputs without unit, using the [1x/Enter] key.
  The menu cursor wraps back to the appropriate parameter.

using rotary knob

- Press the [SELECT] key.
- The menu cursor changes from the parameter selected in the left-hand column of the setting menu to the setting value on the right, e.g. from AM DEPTH to 30%, Fig. 2-4.
- Set the underscore to the position of the setting value to be varied using keys [⇨] [⇦].
- Turn the rotary knob.

  The position underscored is varied in steps of 1.

  Note: *RF frequency and RF level can also be varied in a step width which can be defined arbitrarily using the rotary knob. In the respective setting menu (FREQUENCY or LEVEL) the step width is entered as KNOB STEP USER and the KNOB STEP set from DECIMAL to USER. To point to the fact that the step width has been converted to the value programmed, the underscore as a symbol of the digit cursor disappears in the respective value indication.*

1-out-of-n selection

- Select parameters.
- Press the [SELECT] key.
  The menu cursor changes from the parameter selected in the left-hand column of the setting menu to the current selection on the right, e.g. from AM SOURCE EXT to OFF, Fig. 2-4.
- Set the menu cursor to the position desired within the 1-out-of-n selection using the rotary knob or cursor keys [⇐] [⇒].
- Press the [SELECT] key.
  The setting is made.
  The selection mark which has marked the setting valid up to now wraps to the new position.
- Press the [RETURN] key.
  The menu cursor wraps back to the respective parameter.

Quick selection of a parameter

The quick selection of a parameter reduces the number of operating steps if several parameters are set successively. The menu cursor can directly be set further from line to line in the column of the setting values by pressing the [SELECT] key.

The menu cursor wraps from the setting value of a parameter to the setting value of the parameter in the next line.

The column of the setting values can be exited at each position by pressing the [RETURN] key.

2.2.4 Triggering Action

Lines in the setting menu which are marked with the "▶" symbol at the end of the line qualify an action which can be carried out. Instruction SEARCH ONCE ▶ in the LEVEL-ALC menu, e.g., switches on level control for level calibration for a short period of time.

Trigger action

➢ Set the menu cursor to the respective instruction.

➢ Press the [SELECT] key.

The action is triggered.

While the action is carried out, the instruction remains framed by the selection mark.

2.2.5 Quick Selection of Menu (QUICK SELECT)

The keys of the QUICK SELECT control field are used to call selected menus quickly by one keystroke.

Store menus

➢ Establish the desired operating status of the current menu.

➢ Press the [ASSIGN] key.

➢ Press key [MENU1] or [MENU2].

The current menu is stored as menu1 or menu2. That is to say, 2 menus can be stored in total.

Call menus

➢ Press key [MENU1] or [MENU2].

Menu1 or menu2 stored is displayed. Exactly the operating status which was current at the point of time of storing is reconstructed.

2.2.6 Use of [FREQ] and [LEVEL] Keys

RF frequency and RF level can be set without menu operation as well using direct keys [FREQ] and [LEVEL]. The input value considers the offset, see Sections 2.4 and 2.5.

Key [FREQ]/ [LEVEL]

- ➢ Press the [FREQ] or [LEVEL] key.

  The frequency and/or the level indication in the header field of the display is marked.

  The current menu at the display is maintained.
- ➢ Alter the value via a value input or the rotary knob.
- ➢ Press the [RETURN] key.

  The menu cursor wraps to the position marked last in the menu.

2.2.7 Use of [RF ON/OFF] and [MOD ON/OFF] Keys

RF signal and modulation can be switched on/off without menu operation as well using direct keys [RF ON/OFF] and/or [MOD ON/OFF] (see Sections [RF ON/OFF] key and [MOD ON/OFF] key as well).

Key [RF ON/OFF]

- ➢ Press the [RF ON/OFF] key.

  The RF output signal is switched on/off.

  IEC-bus-short command: `:OUTP OFF`

Key [MOD ON/OFF]

- ➢ Press the [MOD ON/OFF] key.

  The modulation is switched on/off.

A IEC-bus command is not available. The modulations have to be switched on and off in the respective modulation sub menus

2.2.8 Changing Unit of Level

For the level, the unit of the value set can be changed without a new value input.

Change level unit

- ➢ Activate LEVEL parameter.
  - Press the [LEVEL] key or
  - set the menu cursor in the LEVEL menu to the setting value of the AMPLITUDE parameter.
- ➢ Press the unit key with the desired level unit.

  The level is indicated in the desired unit.

2.2.9 Correction of Input

Digital entries can be corrected by one of the following keys before terminating the input:

Key [-/←]	The backspace key deletes the value entered digit by digit. When the last digit is deleted, the previous value is displayed.
Key [RETURN]	Pressing the [RETURN] key deletes the entire entry and results in the previous value being indicated again. For a subsequent new input in the setting menu, the first digit of the new value is to be entered. For a subsequent new input via the [FREQ] or [LEVEL] keys, the respective key has to be pressed again.
Key [FREQ]/ [LEVEL]	In the case of a frequency or level input by means of the [FREQ] or [LEVEL] keys, pressing the [FREQ] and/or [LEVEL] key again deletes the entire input.

2.2.10 Sample Setting for First Users

First users most quickly become familiar with the operation of the instrument if they execute the pattern setting of this section.

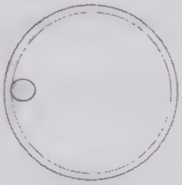
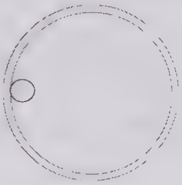
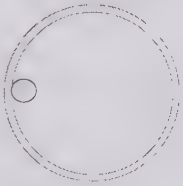
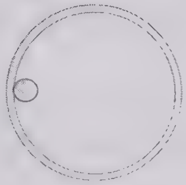
First frequency and level of the RF output signal are set via keys [FREQ] and [LEVEL] in the DATA INPUT field:

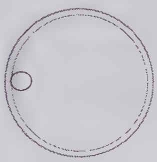
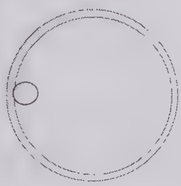
- Frequency	250 MHz
- Level	10 dBm

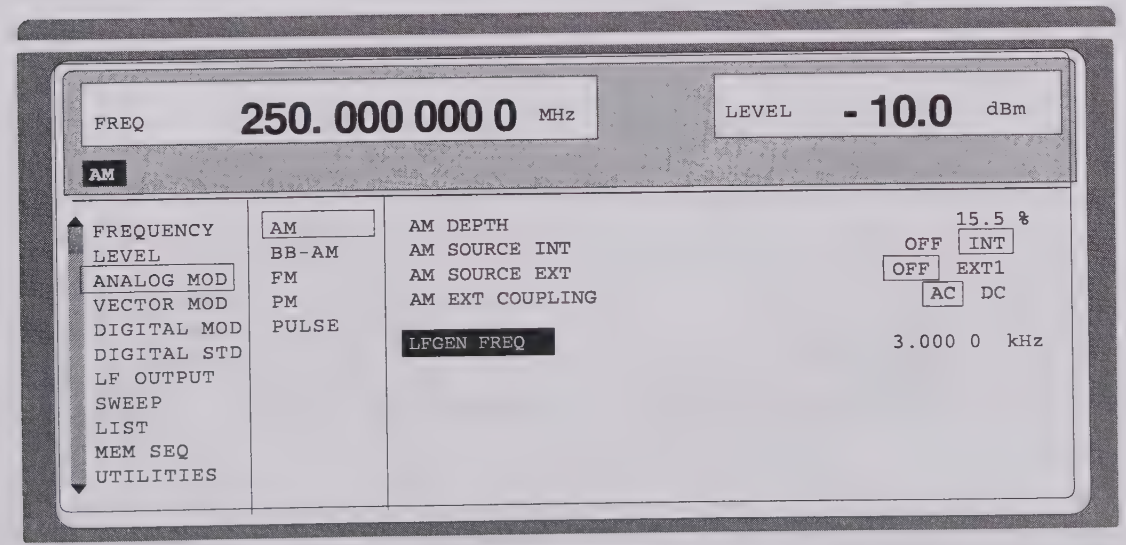
Operating steps	Explanations
PRESET	Reset the instrument to the defined state.
DATA INPUT FREQ 2 5 0 M/μ	Set the frequency to 250 MHz. The menu cursor marks the permanent frequency indication.
DATA INPUT LEVEL 1 0 x1 ENTER	Set the level to 10 dBm. The menu cursor marks the permanent level indication.
RETURN	Reset the menu cursor to the menu field.

The output signal is to be amplitude-modulated next.

- AM modulation depth 15.5 %
- Modulation frequency 3 kHz

Operating steps	Explanations
MENU / VARIATION  ANALOG MOD **MENU / VARIATION** SELECT	Select ANALOG MOD menu. ➢ Set menu cursor to ANALOG MOD using the rotary knob and subsequently press [SELECT] key. The submenu is displayed.
MENU / VARIATION  AM **MENU / VARIATION** SELECT	Select AM submenu The AM setting menu is displayed.
MENU / VARIATION  AM DEPTH	Select AM DEPTH parameter. The menu cursor marks the setting value.
DATA INPUT 1 5 . 5 x1 ENTER	Enter modulation depth 15.5 % and press [x1 ENTER]. The menu cursor is reset to AM DEPTH.
MENU / VARIATION  AM SOURCE INT **MENU / VARIATION** SELECT	Select AM SOURCE INT. The menu cursor marks the current 1-out-of-n selection.

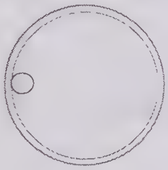
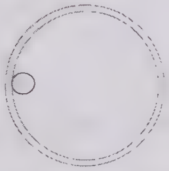
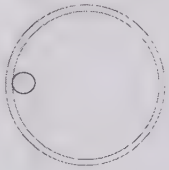
Operating steps	Explanations
MENU / VARIATION  . INT **MENU / VARIATION** SELECT	Select INT 1 as internal modulation source. The selection mark marks INT. AM is faded in the status line as a hint that AM is switched on.
RETURN	Reset menu cursor to AM SOURCE INT.
MENU / VARIATION  LFGEN FREQ	Select parameter LFGEN FREQ.
DATA INPUT 3 k/m	Enter frequency 3 kHz and press unit key. The indications on the display are represented in Fig. 2-5. The AM modulation setting is completed.



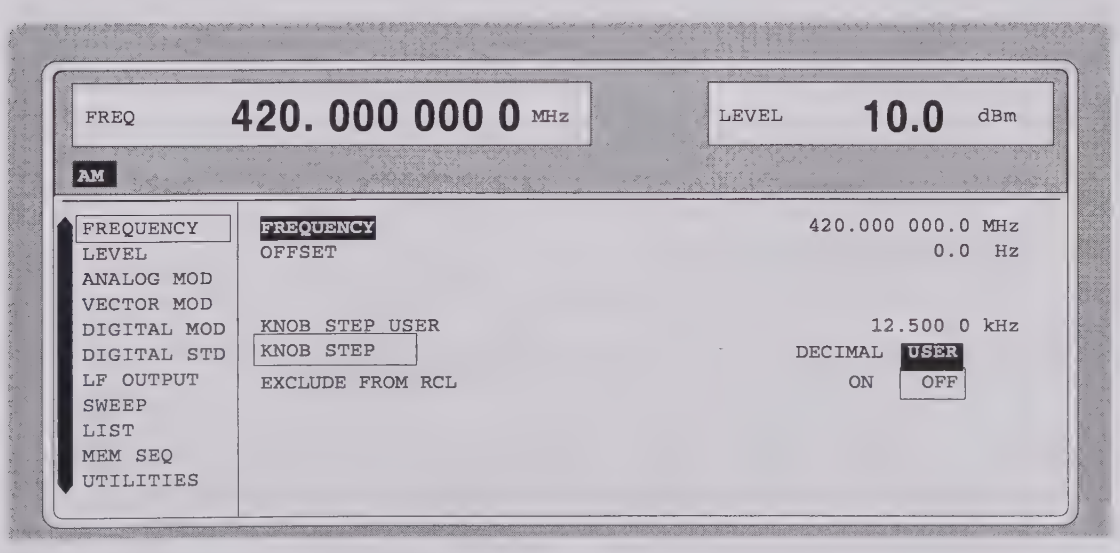
```
FREQ   250. 000 000 0 MHz          LEVEL  - 10.0  dBm
AM

FREQUENCY     AM       AM DEPTH                        15.5 %
LEVEL         BB-AM    AM SOURCE INT               OFF  INT
ANALOG MOD    FM       AM SOURCE EXT               OFF  EXT1
VECTOR MOD    PM       AM EXT COUPLING                AC  DC
DIGITAL MOD   PULSE
DIGITAL STD            LFGEN FREQ                  3.000 0  kHz
LF OUTPUT
SWEEP
LIST
MEM SEQ
UTILITIES
```

Fig. 2-5 Display after AM setting

Subsequently to the above setting, 420 MHz as new RF frequency and 12.5 kHz as the step width for the RF frequency variation are set in the following. Parameter quick select is used, which reduces the number of operating steps.

Operating steps	Explanations
RETURN RETURN	Reset the menu cursor to the main menu in 2 steps.
MENU / VARIATION  FREQUENCY MENU / VARIATION SELECT	Select FREQUENCY menu. The frequency setting menu is displayed.
MENU / VARIATION  FREQUENCY	Select FREQUENCY parameter. The menu cursor marks the setting value.
DATA INPUT 4 2 0 M/μ	Enter frequency 420 MHz and press unit key.
MENU / VARIATION  KNOB STEP USER	Set menu cursor to parameter KNOB STEP USER.
DATA INPUT 1 2 . 5 k/m	Enter step width 12.5 kHz. Press unit key.

Operating steps	Explanations
MENU / VARIATION KNOB STEP	Set menu cursor to parameter KNOB STEP.
SELECT	Set menu cursor to the current KNOB STEP selection.
MENU / VARIATION USER **MENU / VARIATION** SELECT	Select USER (user-defined step width). The selection mark marks USER. This results in step width 12.5 kHz being used in the case of variation using the rotary knob.
RETURN **RETURN**	Reset the menu cursor to the main menu in 2 steps.



FREQ 420. 000 000 0 MHz

LEVEL 10.0 dBm

AM

FREQUENCY
LEVEL
ANALOG MOD
VECTOR MOD
DIGITAL MOD
DIGITAL STD
LF OUTPUT
SWEEP
LIST
MEM SEQ
UTILITIES

FREQUENCY 420.000 000.0 MHz
OFFSET 0.0 Hz

KNOB STEP USER 12.500 0 kHz
KNOB STEP DECIMAL USER
EXCLUDE FROM RCL ON OFF

Fig. 2-6 Display after pattern setting

2.2.11 List Editor

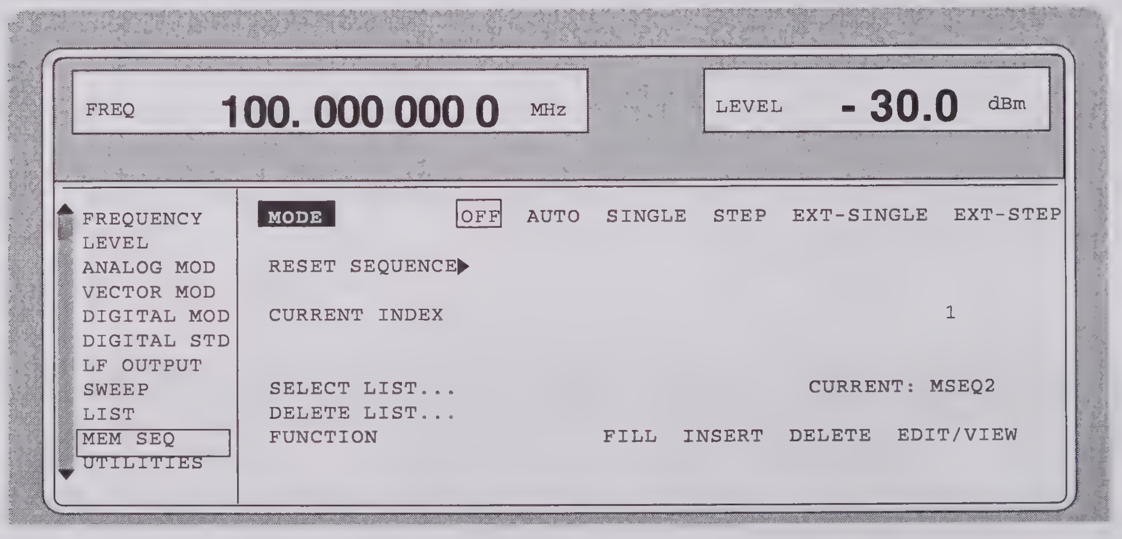
The SMIQ offers the possibility to generate lists. Lists are used for setting sequences LIST mode or (memory sequence), as data source for digital modulations or for level correction which can be defined by the user (UCOR). They consist of elements which are defined by an index and at least one parameter per index. Each list is marked by a separate name and can be selected via this name. The lists are accessed in the menus assigned in each case, e.g. to the settings sequences of instrument settings in the MEM SEQ menu. However, the lists are always generated and processed in the same way and the procedures are hence explained in detail by the example of the memory sequence mode (menu MEM SEQ) in this section. A pattern setting at the end of this section allows the user to become familiar with the operation of the list editor.

Setting menus providing list processing are structured in two pages:

The first page, called OPERATION page in the following contains the general configuration parameters for processing a list. Further, the general list functions such as selecting and deleting the list as well as calling an editing mode are provided. The second page, the EDIT page, is automatically displayed when calling an edit function and serves to enter and modify the parameters of the list.

The OPERATION page has a similar arrangement with all list editors. As an example, the OPERATION page of the MEM SEQ menu is shown:

Menu selection: MEM SEQ


FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

MODE OFF AUTO SINGLE STEP EXT-SINGLE EXT-STEP

RESET SEQUENCE▶

CURRENT INDEX 1

SELECT LIST... CURRENT: MSEQ2

DELETE LIST...

FUNCTION FILL INSERT DELETE EDIT/VIEW

Fig. 2-7 OPERATION page of the MEM SEQ menu

The settings for MODE, CURRENT INDEX, etc. are irrelevant for the general description of the list editors and are described in greater detail in Section 2.10, MEMORY SEQUENCE mode.

The last three menu lines of the OPERATION page always exist and are reserved for selecting and deleting lists as well as for calling the edit functions (and hence the EDIT page).

SELECT LIST	Opens a selection window in which a list can be selected from the existing lists or a new, empty list can be generated. In this line the active list is always displayed.

DELETE LIST	Opens a selection window in which the list to be deleted can be selected.
FUNCTION	Selection of the edit function for processing the lists. The EDIT page is automatically called through the selection (cf. Section 2.2.11.3).

FILL	Filling a list with elements.
INSERT	Insertion of elements into a list.
DELETE	Deletion of elements of a list.
EDIT/VIEW	Editing the single elements.

2.2.11.1 Select and Generate - SELECT LIST

SELECT LIST opens a selection window in which either an existing list can be selected or a new, empty list can be generated (cf. Fig. 2-8). By pressing the [RETURN] key, the selection window is closed without changing the setting.

Select list
- ➤ Mark the list desired using the rotary knob.
- ➤ Press [SELECT] key.

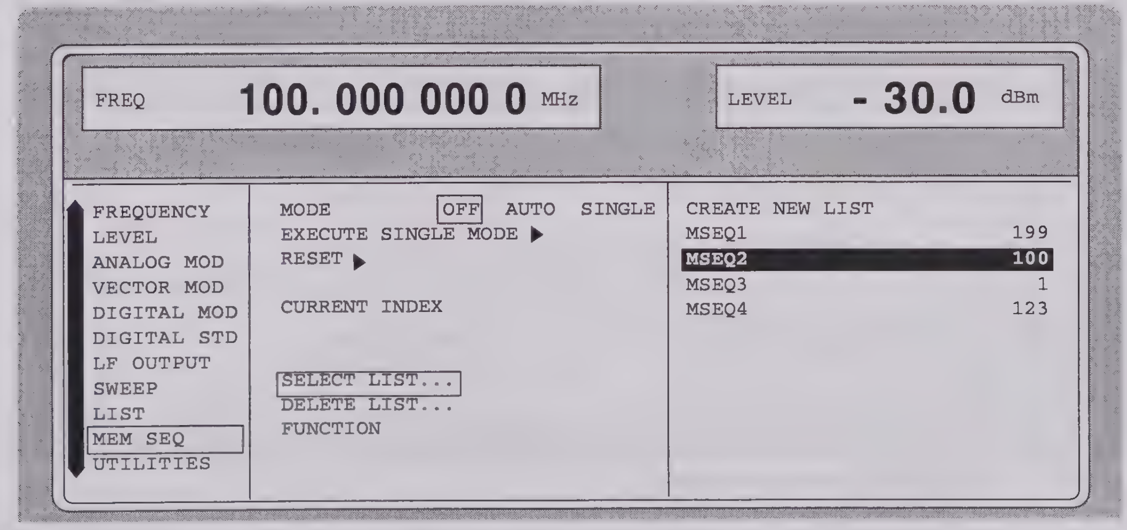
  The selected list is included in the instrument setting. The selection window is closed. The selected list is displayed under CURRENT.

Generate list
- ➤ Mark CREATE NEW LIST ▶ using rotary knob.
- ➤ Press [SELECT] key.

  A new empty list is automatically generated which can be filled using functions FILL or EDIT. The selection window is closed. The new list is displayed under CURRENT.

No modification of the setting
- ➤ Press [RETURN] key.

Selection: SELECT LIST


FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
MODE OFF AUTO SINGLE

CREATE NEW LIST	
MSEQ1	199
MSEQ2	100
MSEQ3	1
MSEQ4	123

Fig. 2-8 SELECT-LIST-selection window

CREATE NEW LIST ▶ Generating a new list. The name of the list cannot be selected freely in the case of manual control. A definite list name is automatically generated in the following form:

MSEQ<n>, with <n> ∈ {0..9}, e.g. MSEQ1 (with Memory Sequence)

This applies correspondingly to the other operating modes. In the case of level correction mode, UCOR1 would be generated for example. If a list is created via IEC bus, an arbitrary list name can be given (cf. Section 3). Unrestricted access is also possible by means of the selection window.

MSEQ2 100 The list currently set is marked in the selection window by means of the selection mark, here MSEQ2. In addition to the list name, the length of the list is given, here 100 elements.

2.2.11.2 Deletion of Lists - DELETE LIST

DELETE LIST opens a selection window in which the list to be deleted can be selected. The lists are represented together with their name and their length (cf. Fig. 2-9). By pressing the [RETURN] key the selection window is exited without deleting a list.

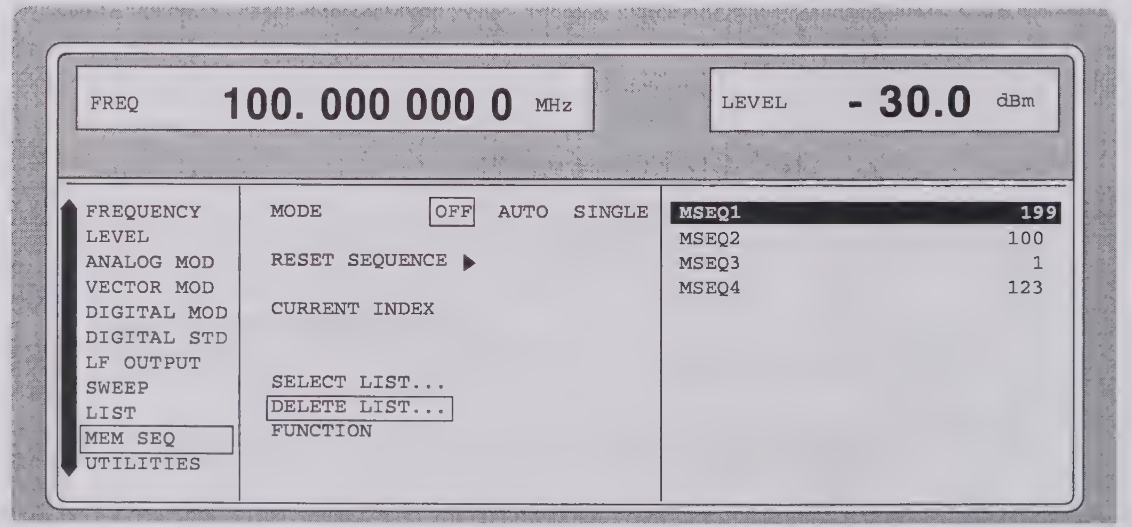
Delete list

- ➢ Mark desired list using the rotary knob.
- ➢ Press [SELECT] key.

  The prompt "enter [SELECT] to delete list/sequence?" is displayed
- ➢ Press [SELECT] key.

  The list is deleted. If the prompt is acknowledged with the [RETURN] key, however, the list is not deleted. The selection window is automatically closed due to the acknowledgment of the prompt.

Selection: DELETE LIST



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

MODE OFF AUTO SINGLE

MSEQ1	199
MSEQ2	100
MSEQ3	1
MSEQ4	123

Fig. 2-9 DELETE-LIST selection window

2.2.11.3 Edition of Lists

Due to the selection of an edit mode on the OPERATION page the EDIT page is automatically activated. When the EDIT/VIEW function is selected, the largest possible section of the list is displayed (cf. Fig. 2-10). In the case of block functions FILL, INSERT and DELETE, an input window is additionally displayed (cf. Fig. 2-11 to 2-13).

Functions SELECT LIST and FUNCTION are available on the EDIT page as on the OPERATION page.

Return to the OPERATION page is effected by pressing the [SELECT] key twice.

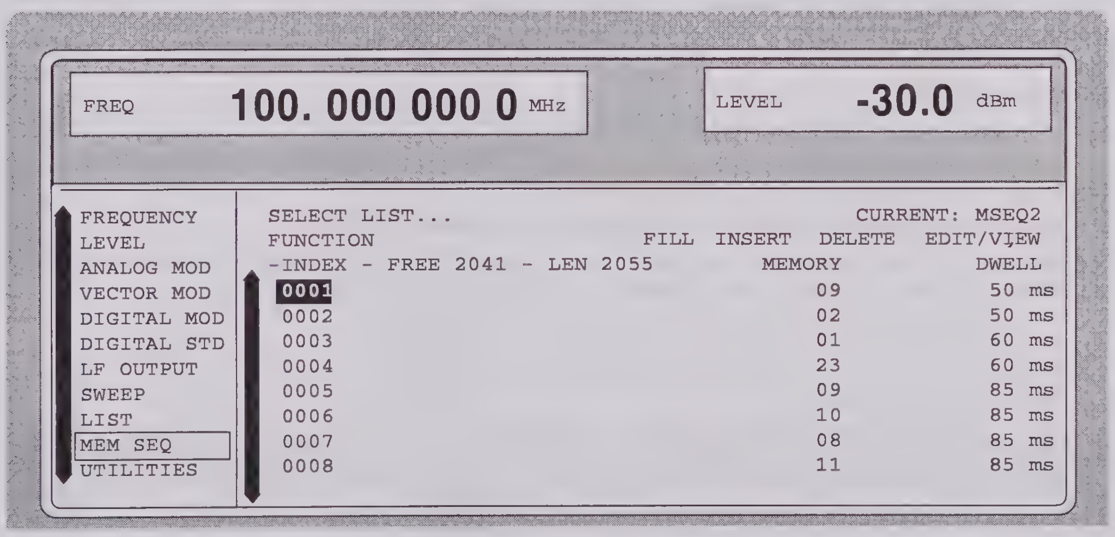
Single-value function EDIT/VIEW

By selecting the EDIT/VIEW function, the entire list can be viewed or modifications of single values be carried out.

If the cursor marks a value in the INDEX column of the list, the EDIT mode is exited by pressing the [RETURN] key. The menu cursor then marks FUNCTION again.

There is no separate function for storing the list. This means that every modification of the list is transferred to the internal data set and has an effect on exiting the EDIT/VIEW function.

Menu selection: FUNCTION EDIT/VIEW



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

SELECT LIST... CURRENT: MSEQ2

FUNCTION

-INDEX - FREE 2041 - LEN 2055	MEMORY	DWELL
0001	09	50 ms
0002	02	50 ms
0003	01	60 ms
0004	23	60 ms
0005	09	85 ms
0006	10	85 ms
0007	08	85 ms
0008	11	85 ms

Fig. 2-10 Edit function EDIT/VIEW

INDEX	Position in the list
FREE	Space available. FREE 2041 means that space for 2041 parameter elements is available in the list memory in total.
LEN	Occupied space. LEN 2055 means that the current list occupies 2055 elements in the list memory.
MEMORY DWELL	Identification of the column below. The number and name of parameter columns is different for the various list editors.

Select parameters

- ➢ Mark the index associated to the parameter using the rotary knob or directly enter the value of the index via the numeric keys.
- ➢ Press [SELECT] key.
  Parameter MEMORY is marked. If the second parameter DWELL is to be marked, press the [SELECT] key again.

Modify parameters

- ➢ Vary the value of the parameter selected using the rotary knob or enter the value directly using numeric keys.

Note: *The binary data of the digital modulations which cannot be varied are an exception. Further, all numeric keys except for "0" and "1" are ineffective in these cases.*

- ➢ Press the [ENTER] key or unit keys.
  The value is included in the data set. The menu cursor marks the value of the next column. In the last column, the menu cursor then marks the next line of column MEMORY.
- ➢ Press the [RETURN] key.
  The menu cursor wraps back to the INDEX column. The EDIT mode is exited by repeatedly pressing the [RETURN] key (cf. Section 2.2.11.4).

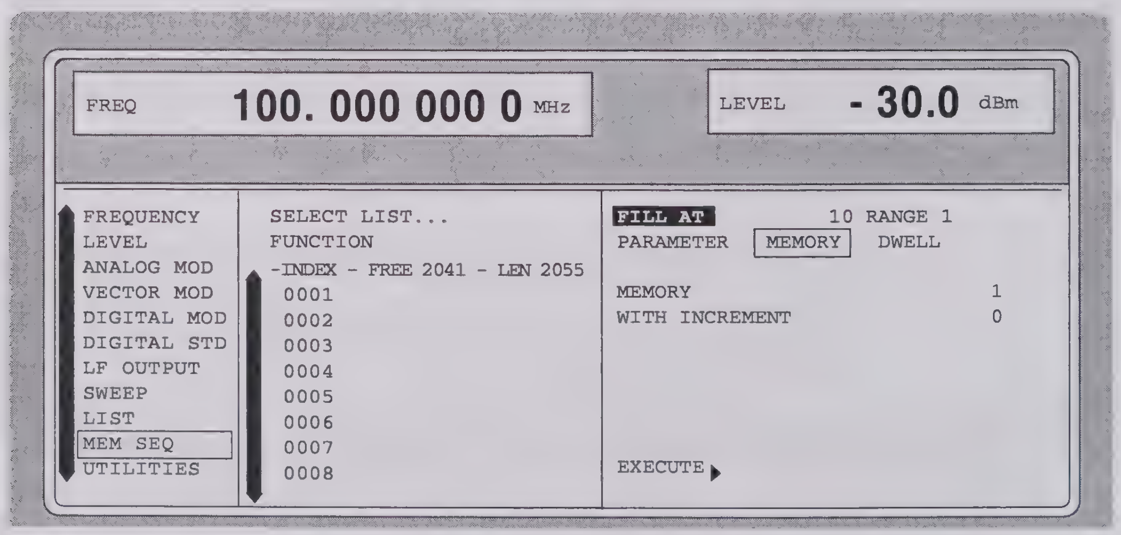
Block function FILL

Using function FILL, a parameter, e.g. MEMORY, is overwritten with constant or linearly increasing/decreasing values within a defined range. The input window is exited by pressing the [RETURN] key without a modification being carried out.
If the filler range exceeds the end of the list, the list is automatically extended.

The list entry, in the example for MEMORY, with index [AT +n] is calculated as follows from the information AT, RANGE, starting value (MEMORY) and WITH INCREMENT:

MEMORY[AT+n] = starting value (MEMORY)+ n · increment | (0 ≤ n ≤ RANGE1)

Selection: FUNCTION-FILL



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

-INDEX - FREE 2041 - LEN 2055
0001
0002
0003
0004
0005
0006
0007
0008

FILL AT 10 RANGE 1
PARAMETER MEMORY DWELL

MEMORY 1
WITH INCREMENT 0

Fig. 2-11 Block function FILL: Input window

FILL AT

Setting the filling range.

AT	Lower limit (index)
RANGE	Number of the elements to be inserted

PARAMETER

Selection on which of the parameters the filling function is to have an effect. This menu option is eliminated if the list only includes elements with one parameter.

MEMORY or DWELL

Input of the starting value for the parameter selected. This option is only displayed if a selection has been made under PARAMETER MEMORY or DWELL.

WITH INCREMENT

Input of the increment between two successive values. If 0 is entered as increment, a filling procedure with constant values is achieved. This option is only displayed if a selection has been made under PARAMETER MEMORY or DWELL.

Note: *In the case of some types of lists, e.g. digital modulation data, indicating an increment is eliminated since there are binary data. In these cases line WITH INCREMENT is eliminated.*

EXECUTE ▶

Starts the filling sequence. After the function has been executed, the input window is automatically exited. The current index points to the first element after the processed range.

Filling a list

After selection of function FILL, the menu cursor marks FILL AT.

- Press the [SELECT] key.
  The menu cursor marks the value at AT.
- Vary index value using the rotary knob or enter using the numeric keys and the [ENTER] key.
- Press the [SELECT] key.
  The menu cursor marks the value at RANGE.
- Vary value using the rotary knob or enter using the numeric keys and the [ENTER] key.
- Press the [SELECT] key.
  The menu cursor marks MEMORY or DWELL in input line PARAMETER.
- Select MEMORY using the rotary knob (if not yet marked) and press the [SELECT] key.
  The menu cursor marks the value in input line MEMORY.
- Vary starting value for column MEMORY using the rotary knob or enter using the numeric keys and the [ENTER] key.
- Press the [SELECT] key
  The menu cursor marks the value in input line WITH INCREMENT.
- Vary the value of the increment desired using the rotary knob or enter using the numeric keys and the [ENTER] key.
- Press the [RETURN] key.
- Mark the action EXECUTE ▶
- Press the [SELECT] key.
  The filling sequence is initiated. After the function has been carried out, the input window is automatically exited. The menu cursor marks FUNCTION. The EDIT page shows the end of the range that has been filled right now.

Block function INSERT

Function INSERT inserts the desired number of elements with constant or linearly increasing/de-creasing values before the element with the given starting index. All elements which had been stored from the starting index are shifted to the end of the range to be inserted.

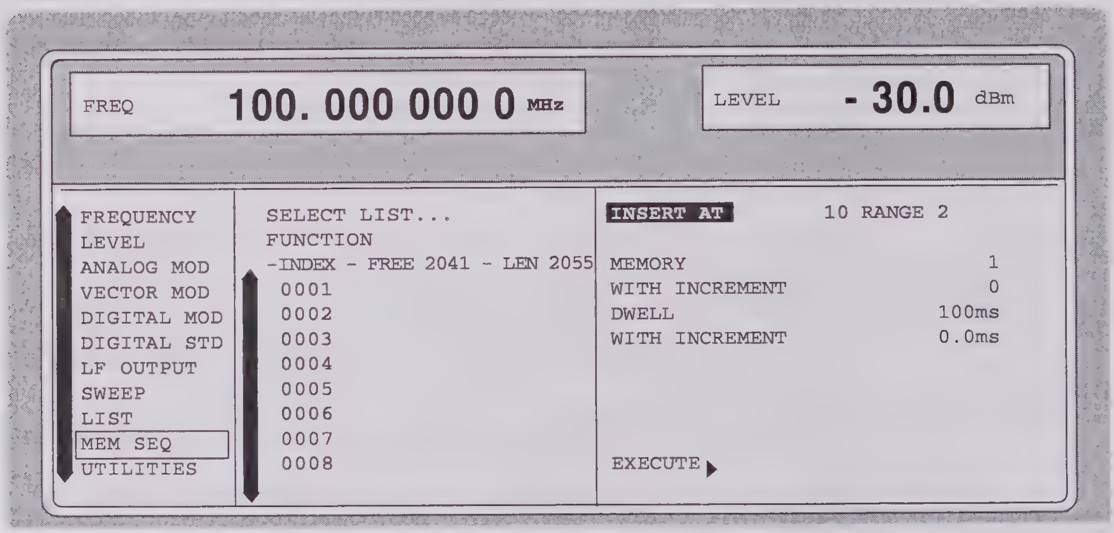
Input is effected analogously to filling a list.

By pressing the [RETURN] key the input window is exited without a modification being effected. The menu cursor then marks FUNCTION.

The list entry, in the example for MEMORY, with index [AT +n] is calculated as follows from the information AT, RANGE, starting value (MEMORY) and WITH INCREMENT:

MEMORY[AT+n] = starting value (MEMORY) + n · Increment | $(0 \leq n \leq \text{RANGE}-1)$

Selection: FUNCTION INSERT



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

SELECT LIST...
FUNCTION
-INDEX - FREE 2041 - LEN 2055
0001
0002
0003
0004
0005
0006
0007
0008

INSERT AT 10 RANGE 2
MEMORY 1
WITH INCREMENT 0
DWELL 100ms
WITH INCREMENT 0.0ms

EXECUTE ▶

Fig. 2-12 Edit function INSERT: Input window

INSERT AT	Input of the starting index and the number of the elements to be inserted. AT Starting index before which the insert operation is to be effective. RANGE Number of the elements to be inserted
MEMORY	Input of the starting value for MEMORY.
DWELL	Input of the starting value for DWELL.
WITH INCREMENT	Input of the increment between two successive values for MEMORY or DWELL. If 0 is indicated as increment, constant values are achieved to be inserted RANGE times. ***Note:*** *In the case of some types of lists, e.g. digital modulation data, indicating an increment is eliminated since there are binary data. In these cases all lines WITH INCREMENT are eliminated.*
EXECUTE ▶	Starts the inserting sequence. After the function has been executed, the input window is automatically exited. The menu cursor marks FUNCTION. The EDIT page shows the beginning of the range that has moved forward.

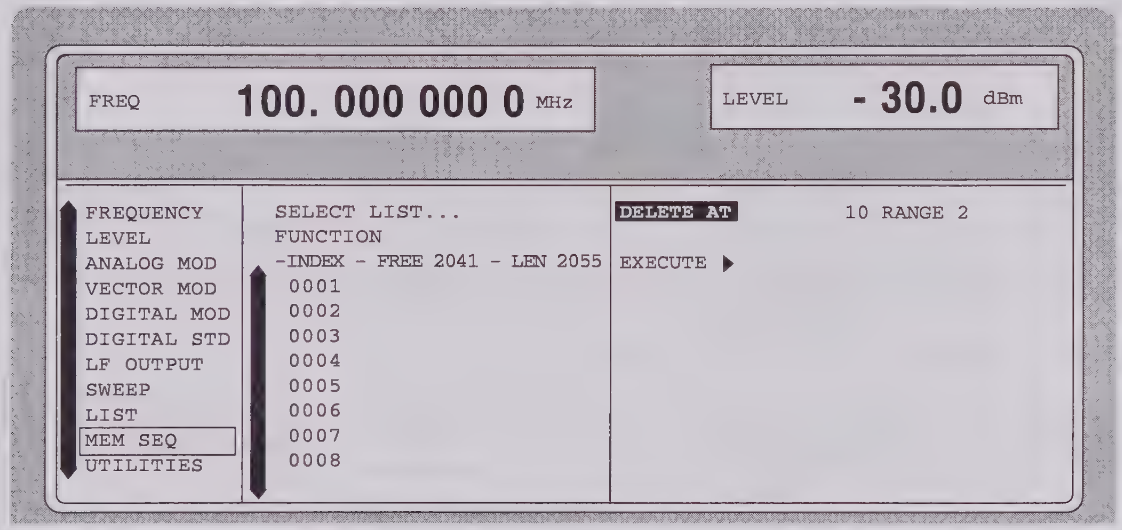
Block function DELETE

Function DELETE deletes the elements of the range indicated. This does not leave a gap in the list but the remaining elements move forward. If the given range exceeds the end of the list, deletion until the end of the list is effected.

Input is analog to filling a list.

By pressing the [RETURN] key, the input window is exited without a modification being carried out. The menu cursor then marks FUNCTION.

Selection: Function DELETE



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

DELETE AT 10 RANGE 2

-INDEX - FREE 2041 - LEN 2055

Fig. 2-13 Edit function DELETE: Input window

DELETE AT	Input of the block of the list to be deleted AT Lower limit (INDEX) RANGE Number of elements to be deleted.
EXECUTE ▶	Starts the deletion. After the function has been executed, the input window is automatically exited. The menu cursor marks FUNCTION. The EDIT page shows the beginning of the range that has moved forward.

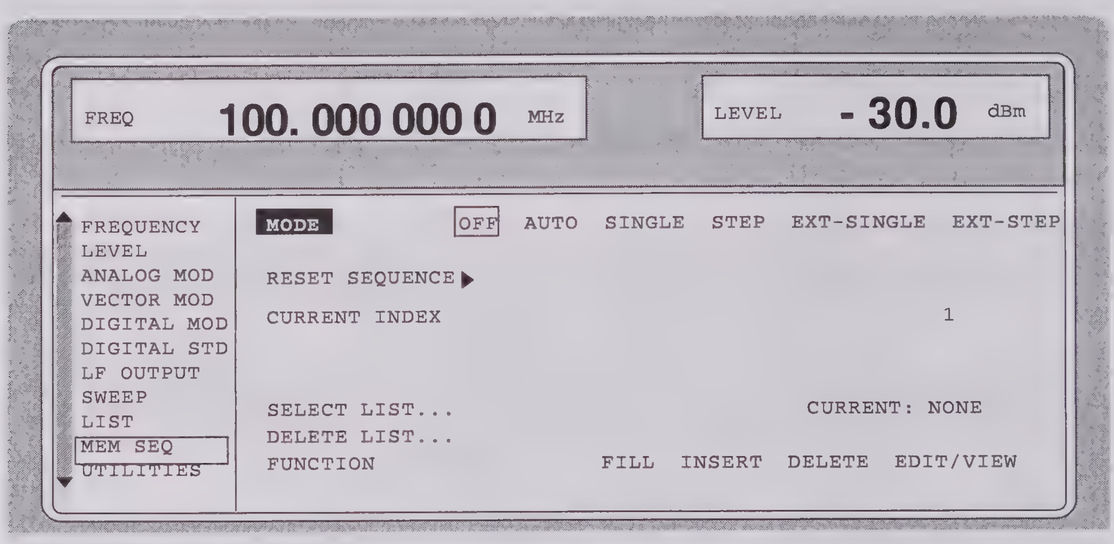
2.2.11.4 Pattern Setting to Operate the List Editor

The user can become familiar with the operation of the list editor by means of the following pattern setting in the MEM SEQ menu. A list has to be generated and filled with values by using the single-value function EDIT/VIEW:

- Memory location number of the first element 20
- Dwell time of the first element 15 s
- Memory location number of the second element 7.

When the setting has been terminated, return to the OPERATION page of the MEM SEQ menu.

At the beginning of the operation sequence, menu MEM SEQ is called. First a list MSEQ0 has to be generated and then activated. The menu cursor marks a parameter of the setting menu on the OPERATION page (c.f. Fig. 2-14).

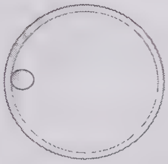
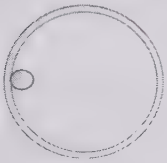
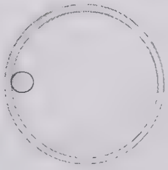


FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

FREQUENCY
LEVEL
ANALOG MOD
VECTOR MOD
DIGITAL MOD
DIGITAL STD
LF OUTPUT
SWEEP
LIST
MEM SEQ
UTILITIES

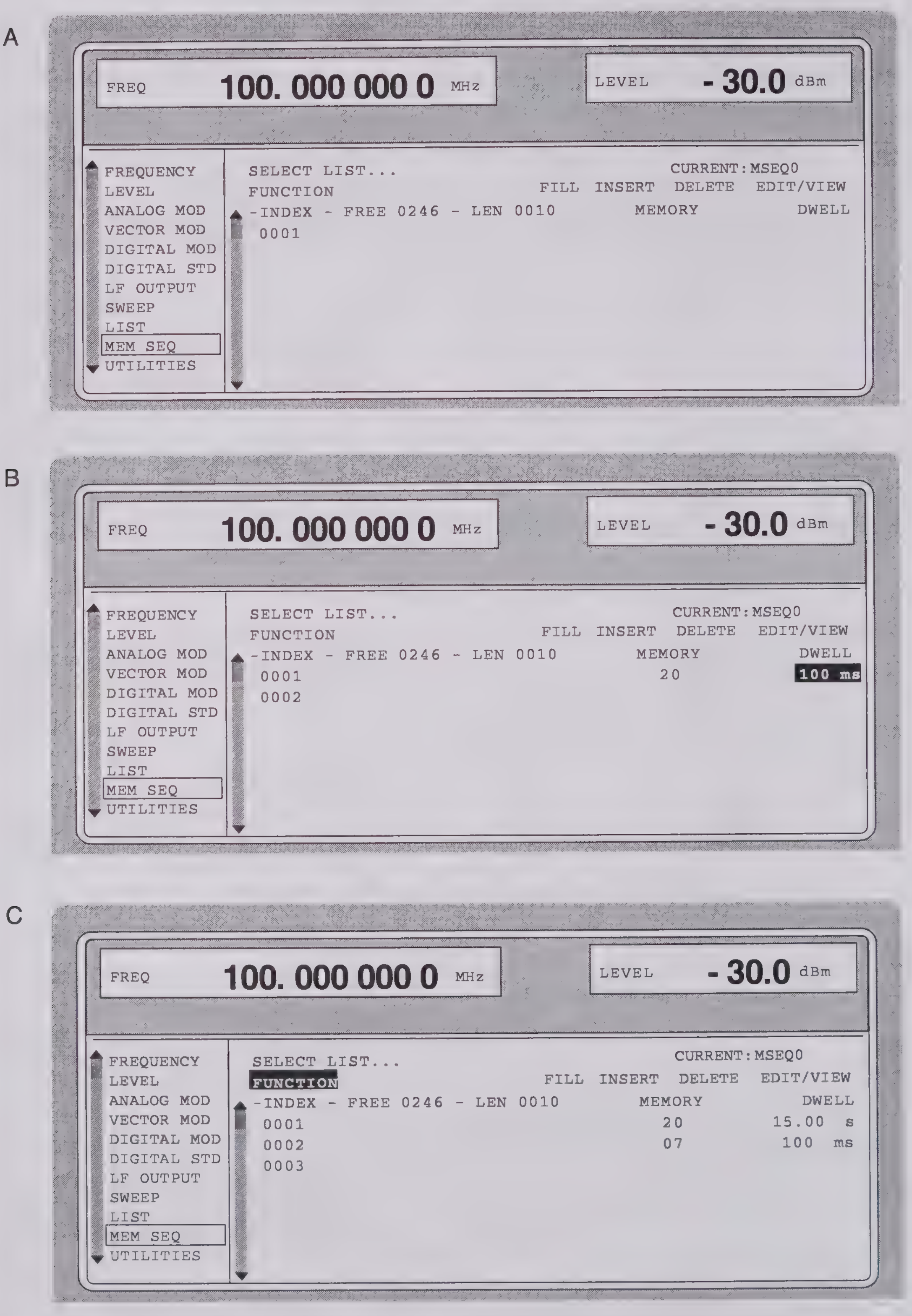
MODE OFF AUTO SINGLE STEP EXT-SINGLE EXT-STEP
RESET SEQUENCE ▶
CURRENT INDEX 1
SELECT LIST... CURRENT: NONE
DELETE LIST...
FUNCTION FILL INSERT DELETE EDIT/VIEW

Fig. 2-14 Starting point of the pattern setting

Operating steps	Explanations
MENU / VARIATION  SELECT LIST... MENU / VARIATION SELECT	Select the SELECT LIST menu item.
MENU / VARIATION  CREATE NEW LIST▶ MENU / VARIATION SELECT	A new list MSEQ0 is generated. The menu cursor is reset to SELECT LIST...
MENU / VARIATION  FUNCTION... MENU / VARIATION SELECT	Select the FUNCTION menu item.

Operating steps	Explanations
MENU / VARIATION .EDIT VIEW. MENU / VARIATION SELECT	Select single-value function EDIT/VIEW. The EDIT page of the MEM SEQ menu is called. The menu cursor marks the index of the first element of list MSEQ0.
SELECT	Set the menu cursor to the memory location number value of the first element (c.f. Fig. 2-15,A).
DATA INPUT 2 0 x1 ENTER	Enter MEMORY 20. The menu cursor automatically wraps to the DWELL value of the first element (Fig. 2-15,B). The default value is 100 ms.
DATA INPUT 1 5 x1 ENTER	Enter DWELL 15 s. The menu cursor automatically wraps to the MEMORY value of the second element.
DATA INPUT 7 x1 ENTER	Enter MEMORY 7. The menu cursor automatically wraps to the DWELL value of the second element (default value is 100 ms).
RETURN	Reset the menu cursor to the index.
RETURN	Reset the menu cursor to the FUNCTION menu item of the EDIT page of menu MEM SEQ (c.f. Fig. 2-15,C).
RETURN	Reset the menu cursor to the FUNCTION menu item of the OPERATION page of menu MEM SEQ.

Note: *With the return to the OPERATION page the operation of the list editor is finished. In the list mode (menu LIST), function LEARN ▶ must be activated subsequently to ensure that the settings are transferred to the hardware*



A

```
FREQ        100. 000 000 0  MHz          LEVEL      - 30.0 dBm

FREQUENCY     SELECT LIST...                              CURRENT:MSEQ0
LEVEL         FUNCTION                          FILL  INSERT  DELETE  EDIT/VIEW
ANALOG MOD    -INDEX - FREE 0246 - LEN 0010          MEMORY              DWELL
VECTOR MOD     0001
DIGITAL MOD
DIGITAL STD
LF OUTPUT
SWEEP
LIST
MEM SEQ
UTILITIES
```

B

```
FREQ        100. 000 000 0  MHz          LEVEL      - 30.0 dBm

FREQUENCY     SELECT LIST...                              CURRENT:MSEQ0
LEVEL         FUNCTION                          FILL  INSERT  DELETE  EDIT/VIEW
ANALOG MOD    -INDEX - FREE 0246 - LEN 0010          MEMORY              DWELL
VECTOR MOD     0001                                   20               100 ms
DIGITAL MOD    0002
DIGITAL STD
LF OUTPUT
SWEEP
LIST
MEM SEQ
UTILITIES
```

C

```
FREQ        100. 000 000 0  MHz          LEVEL      - 30.0 dBm

FREQUENCY     SELECT LIST...                              CURRENT:MSEQ0
LEVEL         FUNCTION                          FILL  INSERT  DELETE  EDIT/VIEW
ANALOG MOD    -INDEX - FREE 0246 - LEN 0010          MEMORY              DWELL
VECTOR MOD     0001                                   20             15.00  s
DIGITAL MOD    0002                                   07               100  ms
DIGITAL STD    0003
LF OUTPUT
SWEEP
LIST
MEM SEQ
UTILITIES
```

Fig. 2-15, a to c Pattern setting - Edition of a list

2.2.12 Save/Recall - Storing/Calling of Instrument Settings

50 complete instrument settings can be stored in memory locations 1 to 50.

Operating steps	Explanations
DATA INPUT SAVE 1 2 x1 ENTER	Store current instrument setting in memory location 12.
DATA INPUT RCL 1 2 x1 ENTER	Call instrument setting of memory location 12.

The digital display during a save or recall entry is faded in a window.

Memory location 0 has a special function. Here the instrument setting which was current prior to the last memory recall and prior to a preset setting is automatically stored. This permits the resetting of instrument settings which have inadvertently been deleted using Recall 0.

If an instrument setting is stored in which a sweep was switched on, the sweep is started using the recall.

The parameter EXCLUDE FROM RCL in the FREQUENCY and LEVEL-LEVEL menus determines whether the saved RF frequency and RF level are loaded when an instrument setting is loaded, or whether the current settings are maintained.

Store IEC-bus command: `"*SAV 12"`

Recall IEC-bus command: `"*RCL 12"`

Notes: - *The contents of lists, as they are used for the Memory Sequence (MSEQ) or for user correction (UCOR), is not saved in the SAVE memory. It is stored under the respective list name and can be called. If instrument settings are called which go back to list data such as level setting using UCOR, the current list contents is used. If this has been altered, it is not identical to the list contents at the point of storing any more.*

- *The frame configurations (digital standards PHS, NADC, PDC, GSM, DECT) and the channel configurations (digital standards CDMA, W-CDMA) are not stored in the SAVE memory either. These settings can be stored and loaded via menu items SAVE/RCL FRAME and SAVE/RCL MAPPING in the corresponding DIGITAL STD menus.*
- *The instruments comprise the "Fast Restore" mode for very fast loading of stored device settings. This mode can be called up only during remote control (see section 3, "Fast Restore Mode").*

2.3 Menu Summary

- FREQUENCY
- LEVEL
  - LEVEL
  - ALC
  - UCOR
  - EMF
- ANALOG MOD
  - AM
  - BB-AM
  - FM (option SM-B5)
  - PM (option SM-B5)
- VECTOR MOD (can be equipped with option SMIQB47)
- DIGITAL MOD (options SMIQB20, SMIQB11 and SMIQB12)
- DIGITAL STD (options SMIQB20, SMIQB11, SMIQB12 and digital standards)
- FADING SIM (options SMIQB14 and SMIQB15)
- NOISE/DIST (option SMIQB17)
- LF OUTPUT
- SWEEP
  - FREQ
  - LEVEL
  - LFGEN
- LIST
- MEM SEQ
- UTILITIES
  - SYSTEM
    - GPIB
    - RS232
    - SECURITY
    - LANGUAGE
  - REF OSC
  - PHASE
  - PROTECT
  - CALIB
    - VCO SUM
    - VECTOR MOD
    - LEV PRESET
    - REF OSC
    - LEVEL
    - ALC TABLE
    - LEV ATT
  - DIAG
    - CONFIG
    - TPOINT
    - C/NMEAS
    - PARAM
  - TEST
  - MOD KEY
  - AUX I/O
  - BEEPER
- HELP

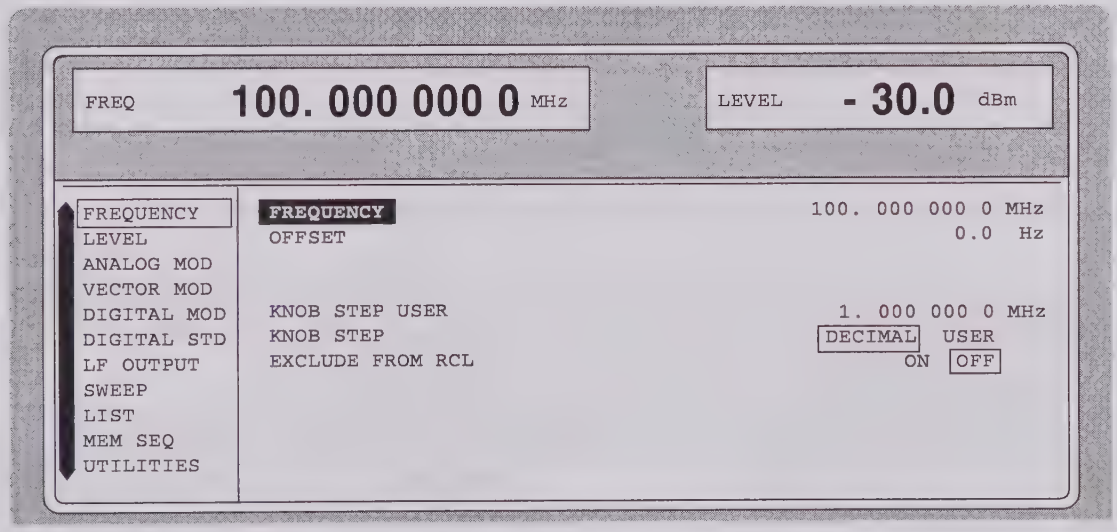
2.4 RF Frequency

The RF frequency can be set directly using the [FREQ] key (cf. Section 2.2.6) or by accessing menu FREQUENCY.
The frequency of the RF output signal is entered/indicated under FREQUENCY in the FREQUENCY menu.
The input value of frequency settings opened by means of the [FREQ] key and indicated in the header line considers the offset in calculation (cf. next Section). This offers the possibility of entering the desired output frequency of possibly series-connected instruments such as mixers in the menu.

Note: *Further settings:*

Frequency sweep	*Menu SWEEP*
LF frequency	*Menu ANALOG MOD* *Menu LF-OUTPUT*
Int./ext. reference frequency	*Menu UTILITIES-REF OSC*
Phase of the output signal	*Menu UTILITIES-PHASE*

Menu selection: FREQUENCY



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

FREQUENCY 100. 000 000 0 MHz
OFFSET 0.0 Hz

KNOB STEP USER 1. 000 000 0 MHz
KNOB STEP [✓ DECIMAL] USER
EXCLUDE FROM RCL ON [✓ OFF]

Fig. 2-16 Menu FREQUENCY (preset setting)

FREQUENCY

Input value of the RF frequency at the RF output connector.

IEC/IEEE-bus command `SOUR:FREQ 100E6`

OFFSET

Input value of the frequency offset, e.g., of a series-connected mixer (cf. Section "Frequency Offset"). The status line indicates FREQ-OFFST.

IEC/IEEE-bus command `SOUR:FREQ:OFFS 0`

KNOB STEP USER

Input value of the step width for frequency variation using the rotary knob. The RF frequency is varied in the step width entered if KNOB STEP is set to USER.

IEC/IEEE-bus command `SOUR:FREQ:STEP 1MHz`

KNOB STEP

DECIMAL: Variation step width corresponding to the position of the digit cursor.

USER: "User Defined", variation step width as entered under KNOB STEP USER .

EXCLUDE FROM RCL	OFF	The saved frequency is also loaded when instrument settings are loaded with the [RCL] key or with a memory sequence. IEC/IEEE-bus command `SOUR:FREQ:RCL INCL`
	ON	The RF frequency is not loaded when instrument settings are loaded, the current frequency is maintained. IEC/IEEE-bus command `SOUR:FREQ:RCL EXCL`

2.4.1 Frequency Offset

The SMIQ offers the possibility of entering an offset (OFFSET) of possibly series-connected instruments in the FREQUENCY menu. The indication/input value of FREQ in the header field considers this input and represents the frequency value of the RF signal at the output of these instruments (cf. Fig. 2-17).

The entry values FREQUENCY and OFFSET in the menu FREQUENCY or FREQ in the header line are related to the RF output frequency as follows :

FREQ - OFFSET = output frequency (= FREQUENCY).

An offset entry causes no modification of the RF output frequency but only a modification of the display value in the FREQ field in the header line, ie FREQ in the header line indicates the offset-associated frequency and FREQUENCY in the menu FREQUENCY the RF output frequency. The status line indicates FREQ-OFFST.

The offset setting also remains effective with the frequency sweep.

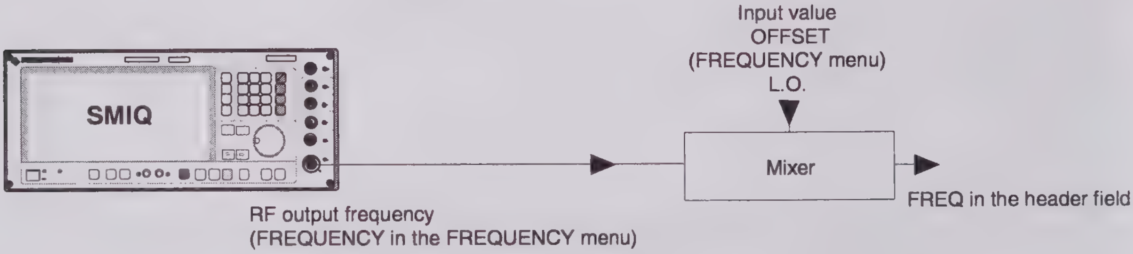


Fig. 2-17 Example of a circuit with frequency offset

2.5 RF Level

The RF level can be set directly using the [LEVEL] key (cf. Section 2.2.6) or by accessing the LEVEL menu.

In the LEVEL-LEVEL menu, the set RF output level is indicated under AMPLITUDE. A two-line level display appears for digital modulation or digital standard. The upper line indicates the average power (LEVEL), the lower line the peak envelope power (PEP) of the modulated RF output signal.

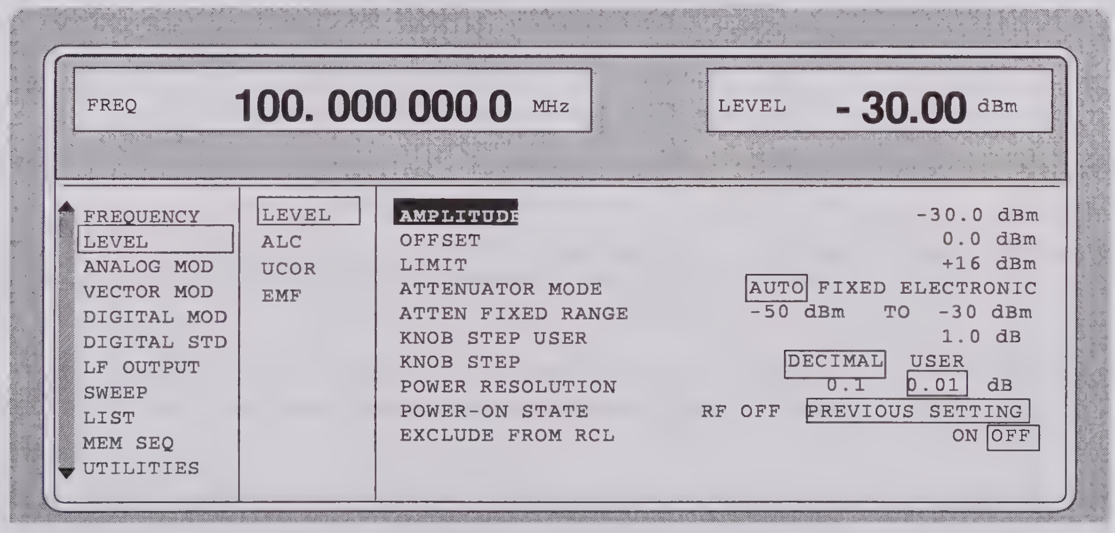
The input value of level settings effected in the LEVEL-LEVEL menu directly corresponds to the RF output level.

The input value of the level settings opened using the [LEVEL] key mathematically considers the offset of an attenuation/amplification element which is possibly series-connected (cf. Section 2.5.1). This offers the possibility of entering the desired level at the output of series-connected instruments, the SMIQ then alters the RF output level correspondingly. The offset can also be entered in the LEVEL-LEVEL menu.

dBm, dBμV, mV and μV can be used as level units. The 4 unit keys are directly labeled with these units. In order to change to another level unit, simply press the desired unit key.

Notes:
- *The message ERROR is displayed in the status line if the level set in the overrange is not reached.*
- *For digital modulation or digital standard, a WARNING message appears in the status line if the set LEVEL or the displayed PEP are overranged. If the set level cannot be generated as an overrange value, ERROR will be displayed.*
- *Further settings: Level sweep   menu SWEEP*

Menu selection: LEVEL - LEVEL



FREQ 100. 000 000 0 MHz
LEVEL - 30.00 dBm

AMPLITUDE -30.0 dBm
OFFSET 0.0 dBm
LIMIT +16 dBm
ATTENUATOR MODE [✓ AUTO] FIXED ELECTRONIC
ATTEN FIXED RANGE -50 dBm TO -30 dBm
KNOB STEP USER 1.0 dB
KNOB STEP [✓ DECIMAL] USER
POWER RESOLUTION 0.1 [✓ 0.01] dB
POWER-ON STATE RF OFF [✓ PREVIOUS SETTING]
EXCLUDE FROM RCL ON [✓ OFF]

Fig. 2-18 Menu LEVEL (preset setting) POWER RESOLUTION is set to 0.01 dB

AMPLITUDE	Input value of the RF level at the RF output connector. IEC/IEEE-bus command `SOUR:POW -30`

OFFSET

Input value of the level offset of the RF output level compared to the input value of the RF level indicated in the LEVEL header field. Input in dB (cf. Section 2.5.1, Level Offset). The status line indicates LEV-OFFST.

IEC/IEEE-bus command `SOUR:POW:OFFS 0`

LIMIT

Input value of level limitation. This value indicates the upper limit of the level at the RF output connector. If a level above this limit is attempted to be set, a warning is displayed in the status line.

IEC/IEEE-bus command `SOUR:POW:LIM 16 dBm`

ATTENUATOR MODE

AUTO Normal operation. The attenuator switching mechanically switches in steps of 5 dB, the switching points being fixed.

IEC/IEEE-bus command `:OUTP:AMOD AUTO`

FIXED Level settings are made in a range of somewhat over 20 dB without switching the attenuator (see section 2.5.2, "Non-interrupting Level Setting"). The range of variation is fixed automatically upon selection of this operating mode. The range is indicated in the ATTEN FIXED RANGE menu. With level settings out of the indicated range, a warning is displayed.

IEC/IEEE-bus command `:OUTP:AMOD FIX`

ELECTRONIC

Level settings are made in a range of somewhat over 90 dB without switching the attenuator (see section 2.5.2, "Non-interrupting Level Setting"). The range of variation is fixed automatically upon selection of this operating mode. The range is indicated in the ATTEN FIXED RANGE menu. With level settings out of the indicated range, a warning is displayed.
This function is only available if the IQMOD module of version VAR 4 or higher is installed (indication in UTILITIES - DIAG - CONFIG menu, IQMOD Var 4 required).

IEC/IEEE-bus command `:OUTP:AMOD ELEC`

ATTEN FIXED RANGE

Indication of the level range in which the level is set without interruption in the "ATTENUATOR MODE FIXED" operating mode.

KNOB STEP USER

Input value of the step width for level variation using the rotary knob. The RF level is varied in the step width entered if KNOB STEP is set to USER.

IEC/IEEE-bus command `SOUR:POW:STEP 1`

KNOB STEP

DECIMAL Variation step width according to the position of the digit cursor.

USER User Defined, variation step width as entered under KNOB STEP USER.

POWER RESOLUTION

Selection of resolution of LEVEL display. For level range -99.9 dBm to +16 dBm the resolution for the level display can be set to 0.1 dB or 0.01 dB.

POWER-ON STATE

Selection of the state the RF output is to assume after power-on of the unit

RF OFF	Output is switched off
PREVIOUS SETTING	Same state as before switch-off
IEC/IEEE-bus command	`:OUTP:PON ON`

EXCLUDE FROM RCL	OFF	The saved RF level is also loaded when instrument settings are loaded with the [RCL] key or with a memory sequence. IEC/IEEE-bus command `SOUR:POW:RCL INCL`
	ON	The RF level is not loaded when instrument settings are loaded, the current level is maintained. IEC/IEEE-bus command `SOUR:POW:RCL EXCL`

2.5.1 Level Offset

The SMIQ offers the possibility of entering the offset (OFFSET) of a possibly series-connected attenuator/amplification element in the LEVEL-LEVEL menu. The indication/input value in the LEVEL header field considers this input (see below) and represents the level value of the signal at the output of the series-connected instrument (cf. Fig. 2-19).

The entry values AMPLITUDE and OFFSET in the menu LEVEL or LEVEL in the header line are related to the RF output level as follows:

LEVEL - OFFSET = output level (= AMPLITUDE)

An offset entry causes no modification of the RF output frequency but only a modification of the display value in the LEVEL field in the header line, ie LEVEL in the header line indicates the offset-associated level and AMPLITUDE in the menu LEVEL the RF output level. The status line indicates LEV-OFFST. The offset is to be entered in dB.

The offset setting also remains effective in the ATTENUATOR MODE FIXED operating mode and with level sweep.

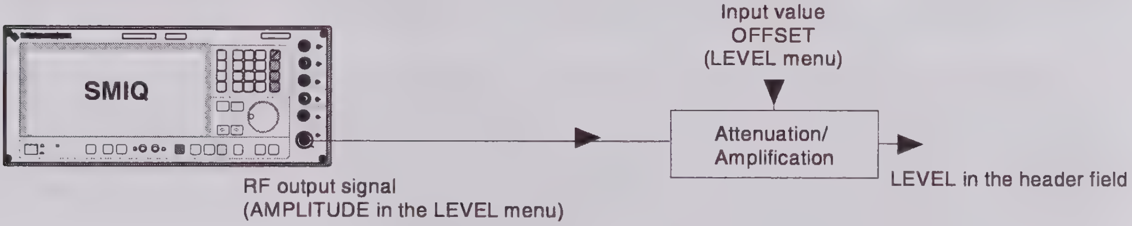


Fig. 2-19 Example of a circuit with level offset

2.5.2 Interrupt-free Level Setting

In the ATTENUATOR MODE FIXED and ATTENUATOR MODE ELECTRONIC operating modes, level settings are carried out without interruption. The attenuator is switched electronically rather than mechanically.
The MODE FIXED variation range is somewhat over 20 dB, the variation range of MODE ELECTRONIC over 90 dB. In case of over- or underranging of the normal variation range, level errors strongly increase and an under/overrange warning is displayed. At high attenuation values the spectral purity of the output signal is degraded.
The ATTENUATOR MODE ELECTRONIC mode is only possible with level control switched off. The ALC OFF mode is automatically set to TABLE.

Note: *To ensure highest level accuracy in ATTENUATOR MODE ELECTRONIC mode, the self calibration routines ALC TABLE and LEV ATT should be called up in the UTILITIES - CALIB menu after temperature variations of more than 5 degrees.*

The MODE ELECTRONIC cannot be used either simultaneously with the SLOT ATTENUATION function of the digital standards. This applies to all TDMA standards. The MODE ELECTRONIC cannot be used either simultaneously with the DIGITAL MOD - POWER RAMP CONTROL - ATTENUATION function.

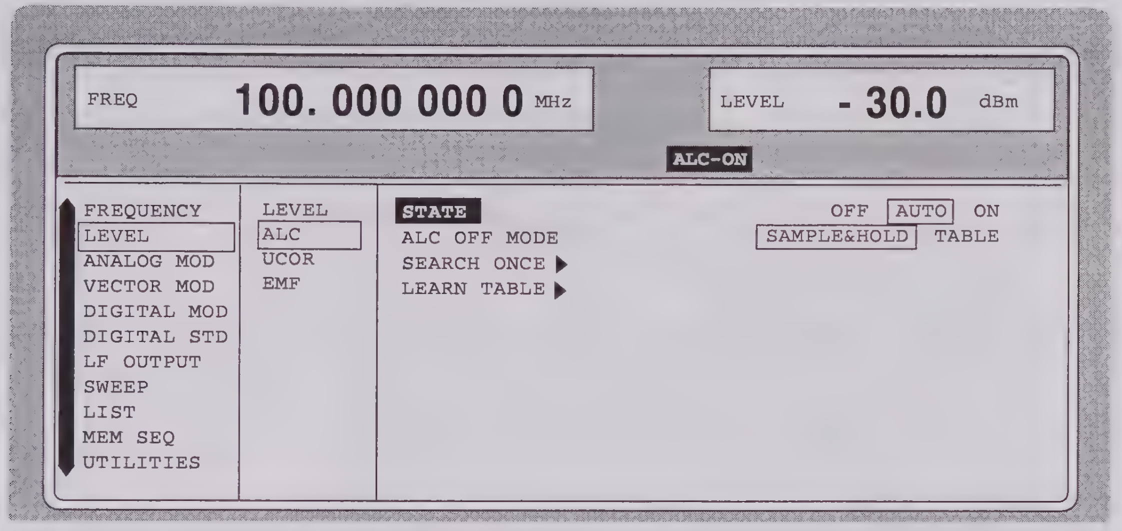
2.5.3 Switching On/Off Internal Level Control

The LEVEL - ALC menu allows the level control to be switched on and off for special applications. In the normal operating mode for CW, AM and FM(PM), level control is switched on so that an optimum level accuracy is obtained. For vector modulation or digital modulation, level control must normally be off. In this case the SAMPLE&HOLD or the TABLE mode can be selected instead.

In the SAMPLE&HOLD mode the level is recalibrated after each level or frequency setting. To do this, CW is selected for a short period of time, level control is switched on and the level control held at the value attained. If this calibration procedure is not desired, the TABLE mode (level control voltage taken from a table) can be selected. In this mode the correction values required after a frequency or level change are obtained from a table. With the LEARN TABLE ▶ function called up, a new table can be prepared without any additional measuring instruments being required.

The preset level control is AUTO. Level control in this mode is automatically adapted to the operating conditions. For special applications, level control can be held in the OFF or ON state. Level control OFF is useful for improving the intermodulation suppression in multi-signal measurements in the CW mode. The ON setting is recommended if vector modulation or digital modulation with a constant envelope curve is required.

Menu selection: LEVEL - ALC



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

ALC-ON

STATE: OFF [✓ AUTO] ON

ALC OFF MODE: [✓ SAMPLE&HOLD] TABLE

Fig. 2-20 Menu LEVEL - ALC (preset setting)

STATE

OFF Internal level control is deactivated. In this state no AM is possible .

IEC/IEEE-bus command `SOUR:POW:ALC OFF`

AUTO Normal state. The internal level control is automatically adjusted to the operating conditions.

IEC/IEEE-bus command `SOUR:POW:ALC AUTO`

ON Internal level control is permanently switched on.

IEC/IEEE-bus command `SOUR:POW:ALC ON`

ALC OFF MODE

SAMPLE&HOLD Level recalibration in the ALC OFF mode after the level or frequency has been set.

IEC/IEEE-bus command `SOUR:POW:ALC:SEAR ON`

TABLE In the ALC OFF mode correction values are taken from a table.

IEC/IEEE-bus command `SOUR:POW:ALC:SEAR OFF`

SEARCH ONCE ▶

Manual short-time switching on of the level control for level calibration in the ALC OFF and SAMPLE&HOLD operating mode.

IEC/IEEE-bus command `SOUR:POW:ALC:SEAR ONCE`

LEARN TABLE ▶

Correction values for the ALC OFF MODE-TABLE function are regenerated (level control voltage obtained from a table).

IEC/IEEE-bus command `SOUR:POW:ALC:TABL?`

2.5.4 User Correction (UCOR)

Function "User Correction" can be used to create and activate lists in which arbitrary RF frequencies are assigned level correction values.

Up to 10 lists with a total of 160 correction values can be compiled. For frequencies which are not included in the list the level correction is determined by means of interpolation of the nearest correction values.

When user correction is switched on, the LEVEL indication is completed by the indication UCOR (User Correction) in the header field of the display. The RF output level is the sum of both values.

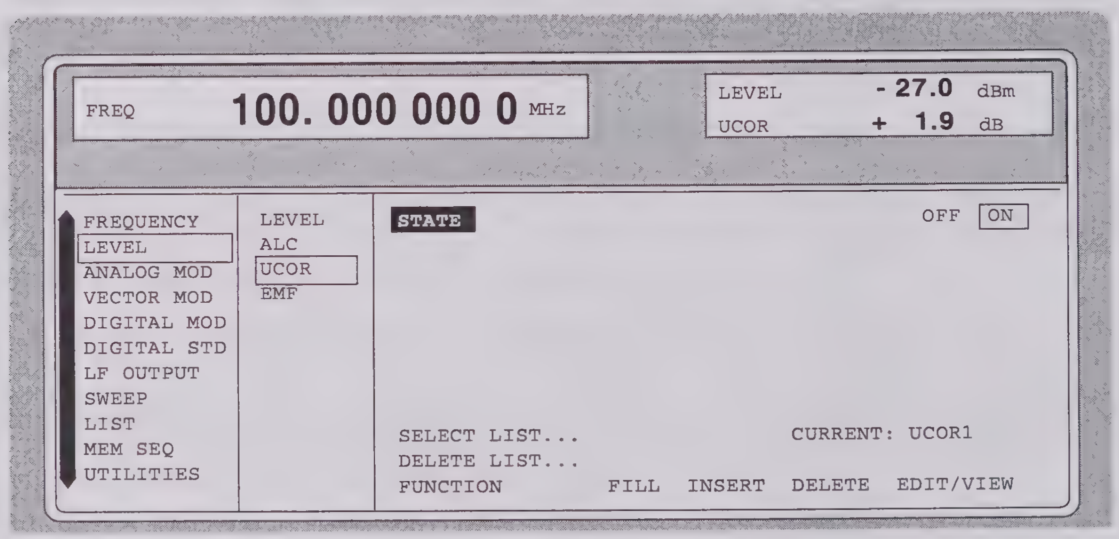
LEVEL + UCOR = output level

If the offset setting is used at the same time, the LEVEL indication value is the difference of the input values AMPLITUDE and OFFSET of the menu LEVEL.

AMPLITUDE - OFFSET = LEVEL

The user correction is effective in all operating modes if switched on.

Menu selection: LEVEL - UCOR



FREQ 100. 000 000 0 MHz

LEVEL - 27.0 dBm

UCOR + 1.9 dB

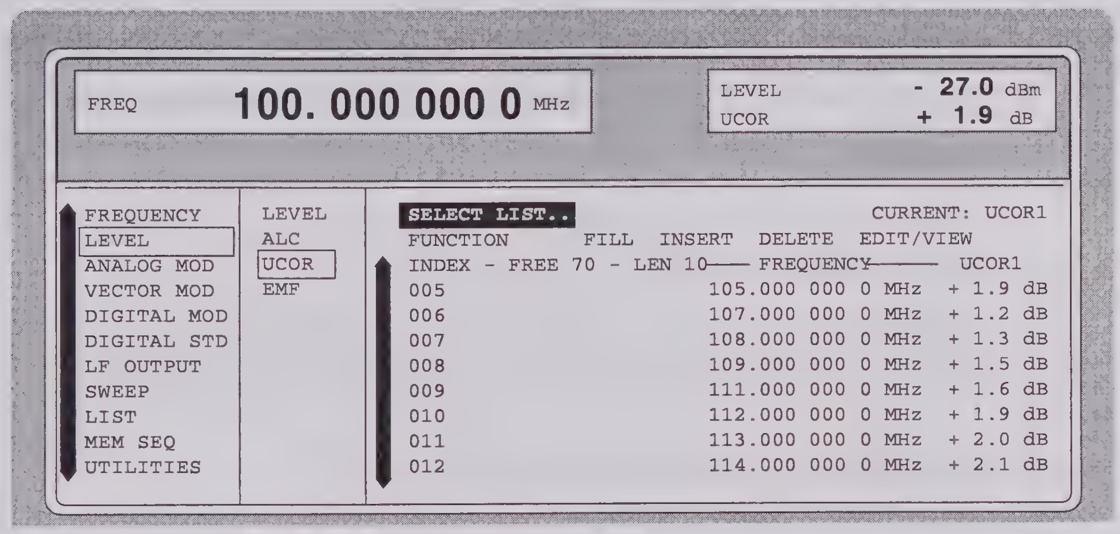
STATE OFF ON

CURRENT: UCOR1

Fig. 2-21 Menu LEVEL - UCOR - OPERATION side

STATE	Switching on/off user correction. IEC/IEEE-bus command `SOUR:CORR ON`
SELECT LIST...	Selection of a list or generation of a new list (cf. Section 2.2.11, List Editor). IEC/IEEE-bus command `SOUR:CORR:CSET "UCOR1"`
DELETE LIST...	Deletion of a list (cf. Section 2.2.11, List Editor). IEC/IEEE-bus command `SOUR:CORR:CSET:DEL "UCOR2"`
FUNCTION	Selection of the editing mode to process the selected list (cf. Section 2.2.11, List Editor). IEC-bus commands `SOUR:CORR:CSET:DATA:FREQ 100 MHz, 102 MHz,...` `SOUR:CORR:CSET:DATA:POW 1dB, 0.8dB,...`

Menu selection: LEVEL - UCOR



FREQ 100. 000 000 0 MHz

LEVEL - 27.0 dBm

UCOR + 1.9 dB

CURRENT: UCOR1

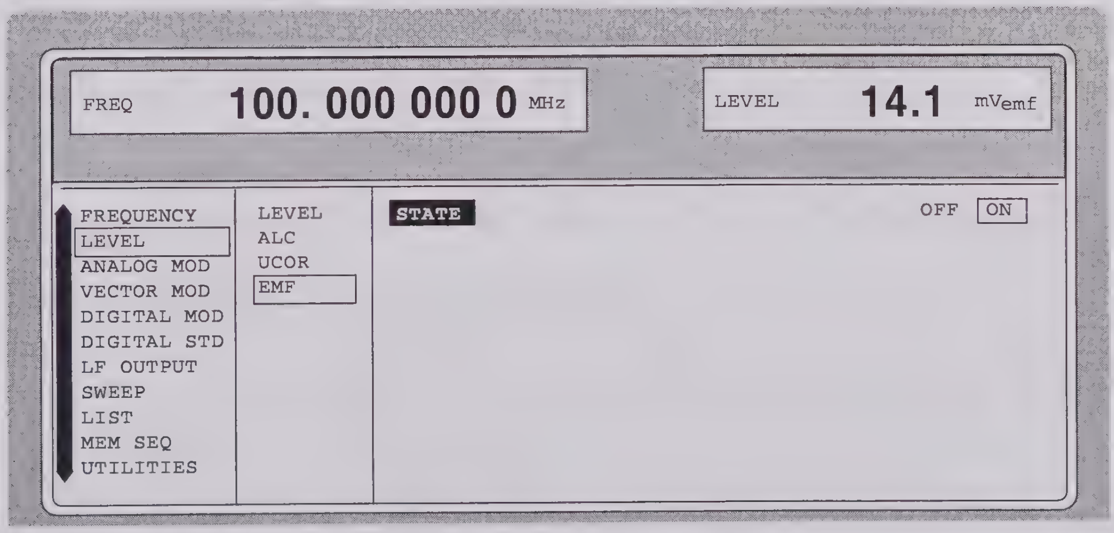
INDEX - FREE 70 - LEN 10	FREQUENCY	UCOR1
005	105.000 000 0 MHz	+ 1.9 dB
006	107.000 000 0 MHz	+ 1.2 dB
007	108.000 000 0 MHz	+ 1.3 dB
008	109.000 000 0 MHz	+ 1.5 dB
009	111.000 000 0 MHz	+ 1.6 dB
010	112.000 000 0 MHz	+ 1.9 dB
011	113.000 000 0 MHz	+ 2.0 dB
012	114.000 000 0 MHz	+ 2.1 dB

Fig. 2-22 Menu UCOR - LEVEL-EDIT side

2.5.5 EMF

The signal level can also be set and indicated as the voltage of EMF (open-circuit voltage). EMF is displayed in the header field of the display after the unit of the level indication.

Menu selection: LEVEL - EMF



FREQ 100. 000 000 0 MHz

LEVEL 14.1 mV$_{emf}$

STATE OFF [✓ ON]

Fig. 2-23 Menu LEVEL-EMF

STATE	ON	Voltage value of the level is the voltage of EMF.
	OFF	Voltage value of the level is voltage at 50 Ω (preset setting).

2.5.6 [RF ON / OFF]-Key

The RF output signal is switched on and off again using the [RF ON / OFF] key. This does not influence the current menu. When the output signal is switched off, the message "RF OFF" is displayed in the LEVEL indication of the header field. If RF OFF is displayed, the 50-Ω source resistance is maintained.

IEC/IEEE-bus command `:OUTP OFF`

2.5.7 Reset Overload Protection

The SMIQ is protected against overload by an external signal which is fed into the RF output. If an external signal is too high, the overload protection responds. This state is indicated by means of the message "RF OFF" in the LEVEL indication in the header field and the message "OVERLOAD" in the status line.

➢ Reset the overload protection by pressing the [RF ON / OFF] key.

IEC/IEEE-bus command `:OUTP:PROT:CLE`

2.6 Modulation - General

The SMIQ offers the following modulations and digital standards:

- Analog modulations
  - Amplitude modulation (AM)
  - Broadband AM (BB-AM)
  - Frequency modulation (FM; with option SM-B5 only)
  - Phase modulation (PM; with option SM-B5 only)
  - Pulse modulation (PULSE)
- Vector modulation (VECTOR MOD)
- Digital modulation (DIGITAL MOD; option SMIQB20)
- Digital standards (DIGITAL STD - PHS; IS95/CDMA - option SMIQB42; NADC; PDC; GSM; DECT; W-CDMA - option SMIQB43; options SMIQB20 and SMIQB11)

For AM, FM, PM and digital modulation internal or external modulation sources can be used.
For BB-AM, pulse and vector modulation only external modulation sources can be used.

2.6.1 Modulation Sources

Internal Modulation Sources

The internal modulation generator LF GEN is available for AM, FM and PM. The generator supplies sinusoidal signals in the frequency range from 0.1 Hz to 1 MHz. For a more detailed description, cf. Section "LF Generator".

The internal modulation coder (option SMIQB20) supplies PRBS signals, clock signals or modulation data for the digital modulations. The data generator (option SMIQB11) supplies modulation data and control signals. For a more detailed description, cf. Section "Digital Modulations".

External Modulation Sources

The appropriate input sockets to the different modulations in the case of external supply can be taken from Table 2-1.

Table 2-1 Input sockets for the different types of modulation

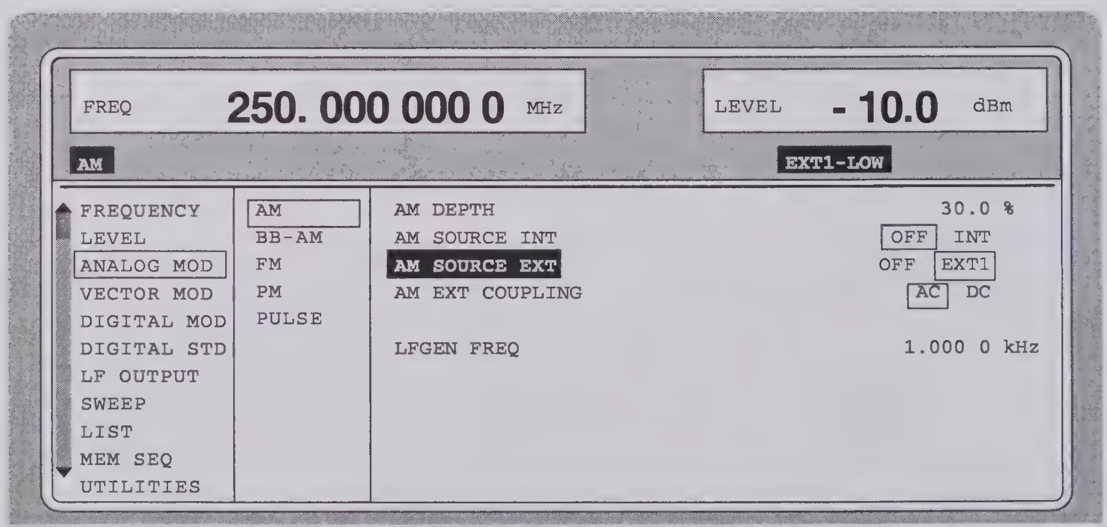
Modulation	Input									
	EXT1	EXT2	PULS (AUX)	I	Q	DATA	PAR DATA	BIT CLOCK	SYMBOL CLOCK	POW RAMP
AM	X									
BB-AM				X						
FM1	X	X								
FM2	X	X								
PM1	X	X								
PM2	X	X								
PULSE			X							
VECTOR MOD				X	X					X
DIGITAL MOD						X	X	X	X	X

EXT1/EXT2-Inputs

The external modulation signal for AM, FM and PM at inputs EXT1 and EXT2 must show a voltage of V_s = 1 V (V_{eff} = 0.707 V) in order to maintain the modulation depth or deviation indicated. A monitoring circuit checks the input voltage in the frequency range 10 Hz to 100 kHz. Deviations of more than ±3 % are signaled in the status line by means of the following messages (cf. Table 2-2). The inputs EXT1 and EXT2 can be AC- or DC-coupled. Monitoring is only active if the inputs are AC-coupled.

Table 2-2 Status messages in the case of a deviation from the rated value at the external modulation inputs EXT1 and EXT2

Message	**Deviation**
EXT1-HIGH	Voltage at EXT1 too high
EXT1-LOW	Voltage at EXT1 too low
EXT2-HIGH	Voltage at EXT2 too high
EXT2-LOW	Voltage at EXT2 too low
EXT-HI/HI	Voltage at EXT1 and EXT2 too high
EXT-LO/LO	Voltage at EXT1 and EXT2 too low
EXT-HI/LO	Voltage at EXT1 too high and EXT2 too low
EXT-LO/HI	Voltage at EXT1 too low and EXT2 too high



FREQ 250. 000 000 0 MHz

LEVEL - 10.0 dBm

AM DEPTH 30.0 %

AM SOURCE INT OFF INT

AM SOURCE EXT OFF EXT1

AM EXT COUPLING AC DC

LFGEN FREQ 1.000 0 kHz

Fig. 2-24 Example: Status message "EXT1-LOW" in case of voltage at EXT1 too low

I/Q-Inputs

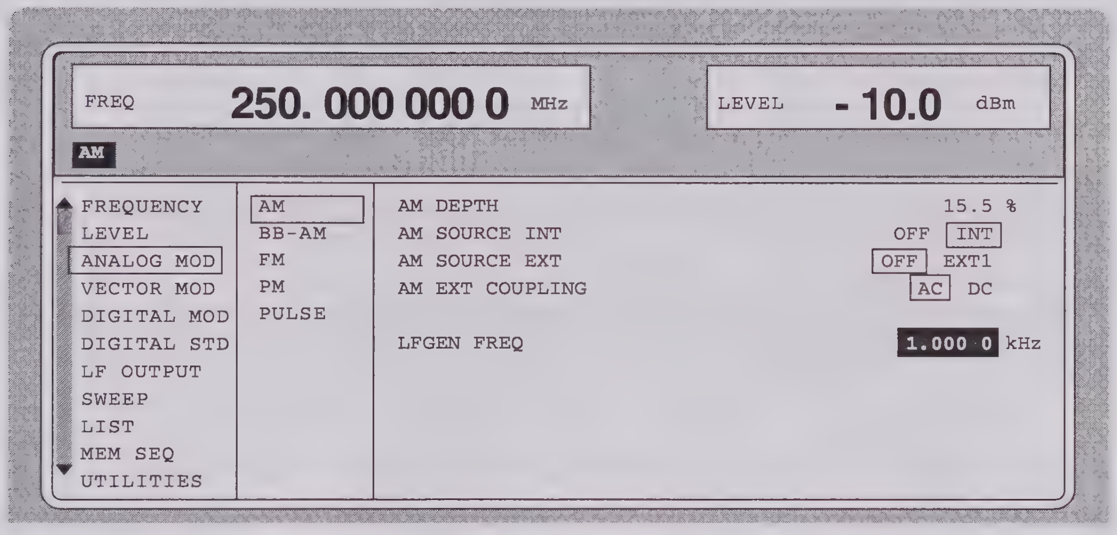
The nominal voltage at the I/Q-inputs for external vector modulation is U_S = 0.5 V. Input resistance is 50 Ω. For a more detailed description, cf. Section "Vector Modulation".

For external broadband AM the I-input is used. Input sensitivity is 0,25 V for 100% AM.

2.6.2 LF-Generator

The SMIQ is equipped with a LF-generator as internal modulation source as a standard. The generator supplies sinusoidal signals in the frequency range from 0.1 Hz to kHz.

The frequency settings of the internal modulation signals can be made in one of the modulation menus (AM, FM, PM) as well as in the LF-output menu. Figure 2-25 shows the setting parameters using the the AM menu as an example.



FREQ 250. 000 000 0 MHz

LEVEL - 10.0 dBm

AM DEPTH 15.5 %

AM SOURCE INT OFF [✓ INT]

AM SOURCE EXT [✓ OFF] EXT1

AM EXT COUPLING [✓ AC] DC

LFGEN FREQ 1.000 0 kHz

Fig. 2-25 Example: Settings of the LF generator in the AM menu

2.6.3 Simultaneous Modulation

Combination of AM and FM as well as AM and vector modulation is possible. Instead of FM, phase modulation (PM) can be switched on as well.

Two-tone AM is possible by simultaneously switching on the external and internal source.

Two-tone FM or two-tone PM is possible by simultaneously switching on FM1 and FM2 or PM1 and PM2. For FM1 and FM2 (PM1 and PM2) separate deviations can be set and separate sources switched on.

Note: *With two-tone modulation please observe that the set deviation or modulation depth is valid for one signal and the sum deviation or sum modulation depth is determined by adding both signals. This results in overmodulation if the maximal value for deviation or modulation depth is exceeded.*

2.6.4 [MOD ON/OFF] Key

The modulations can directly be switched on/off using the key or by accessing the modulation menus. When switching on using the [MOD ON/OFF] key, the modulation sources which are set in the modulation menus are used.

The [MOD ON/OFF] key can either be effective for all modulations or for a selected modulation. The selection for which modulation the [MOD ON/OFF] key is effective is made in the UTILITIES-MOD KEY menu (cf. Section "Assigning Modulation to [MOD ON/OFF] Key").

When selecting a certain type of modulation, each pressing the [MOD ON/OFF] key switches on or off the modulation selected.

In the case of selection "all modulations", the [MOD ON/OFF] key has the following effect:

- At least one modulation is active:
  Pressing the [MOD ON/OFF] key switches off all active modulations. Which modulations were active is stored.
- No modulation is active:
  Pressing the [MOD ON/OFF] key switches on the modulations which were last switched off using the [MOD ON/OFF] key.

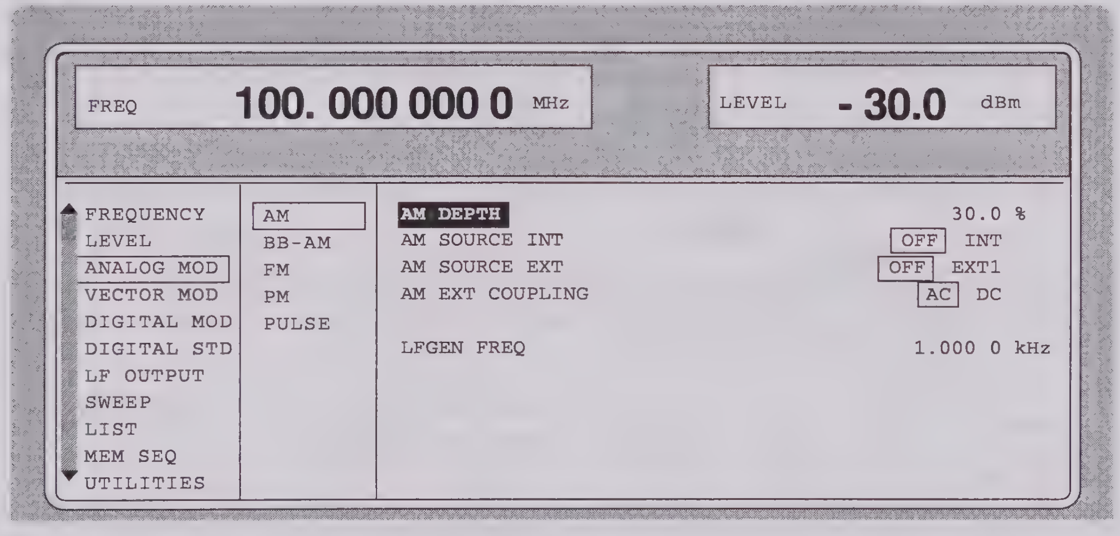
2.7 Analog Modulations

2.7.1 Amplitude Modulation

Menu ANALOG MOD-AM offers access to settings for amplitude modulation.

Notes:
- *In the level range from 7 to 13 dBm, the specified AM data are only guaranteed for a linearly decreasing modulation depth with a rising level. When a modulation depth is set that is too high, "WARNING" is displayed in the status line or the message "WARN -221 Settings conflict; modulation forces peak level into overrange" is displayed after pressing the ERROR key.*
- *For AM, setting LEVEL-ALC-STATE ON or AUTO is recommended.*

Menu selection: ANALOG MOD - AM



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

AM DEPTH 30.0 %
AM SOURCE INT OFF INT
AM SOURCE EXT OFF EXT1
AM EXT COUPLING AC DC

LFGEN FREQ 1.000 0 kHz

Fig. 2-26 Menu ANALOG MOD-AM (preset setting)

AM DEPTH	Input value of the modulation depth.. IEC/IEEE-bus command `SOUR:AM 30PCT`
AM SOURCE INT	Selection of the internal source. IEC/IEEE-bus command `SOUR:AM:SOUR INT1; STAT ON`
AM SOURCE EXT	Selection of the external source. IEC/IEEE-bus command `SOUR:AM:SOUR EXT; STAT  ON`
AM EXT COUPLING	Selection of the kind of coupling AC or DC with external supply (input EXT1). IEC/IEEE-bus command `SOUR:AM:EXT:COUP AC`
LFGEN FREQ	Input value of the frequency of the LF generator. IEC/IEEE-bus command `SOUR:AM:INT:FREQ 1kHz`

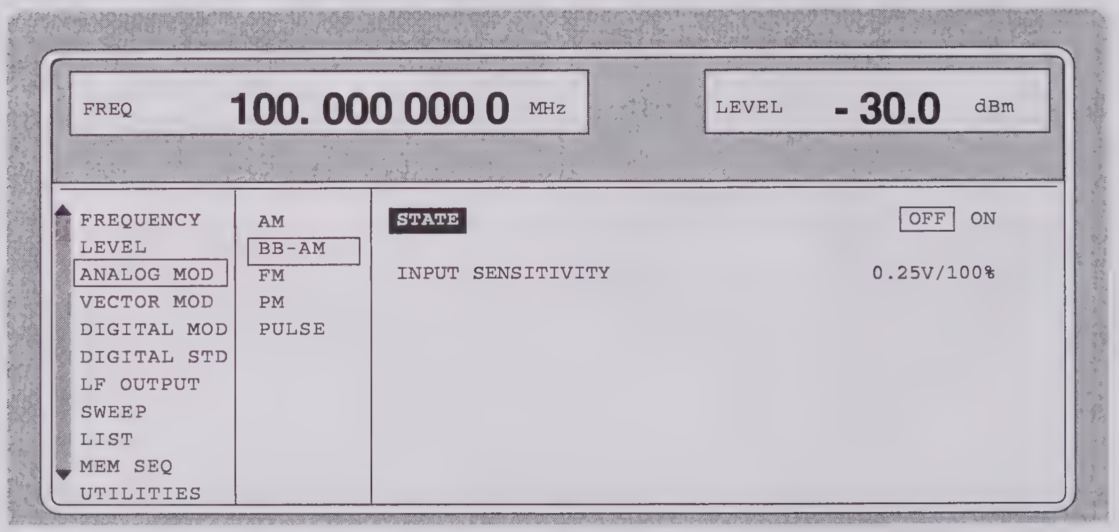
2.7.2 Broadband AM (BB-AM)

In the BB-AM mode the I/Q modulator is used for amplitude modulation. Level control should be set to AUTO or ON (see section, Switching On/Off Internal Level Control).

The modulation input (BB-AM) is identical with the I input of the I/Q modulator. The input impedance is 50 Ω. A signal of -0.25 V bis +0.25 V corresponds to an amplitude modulation of -100% to +100%. Setting the modulation depth with BB-AM is not possible.

Notes:
- *Broadband AM is specified up to +7 dBm. When a higher level is set WARNING is displayed in the status line.*
- *Broadband AM cannot be selected together with normal AM or vector modulation. These modulation deactivate one another*

Menu selection: ANALOG MOD - BB-AM



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

STATE OFF ON

INPUT SENSITIVITY 0.25V/100%

Fig. 2-27 Menu ANALOG MOD - BB-AM (preset setting)

STATE Switches BB-AM on and off.
IEC/IEEE-bus command `SOUR:AM:BBAN ON`

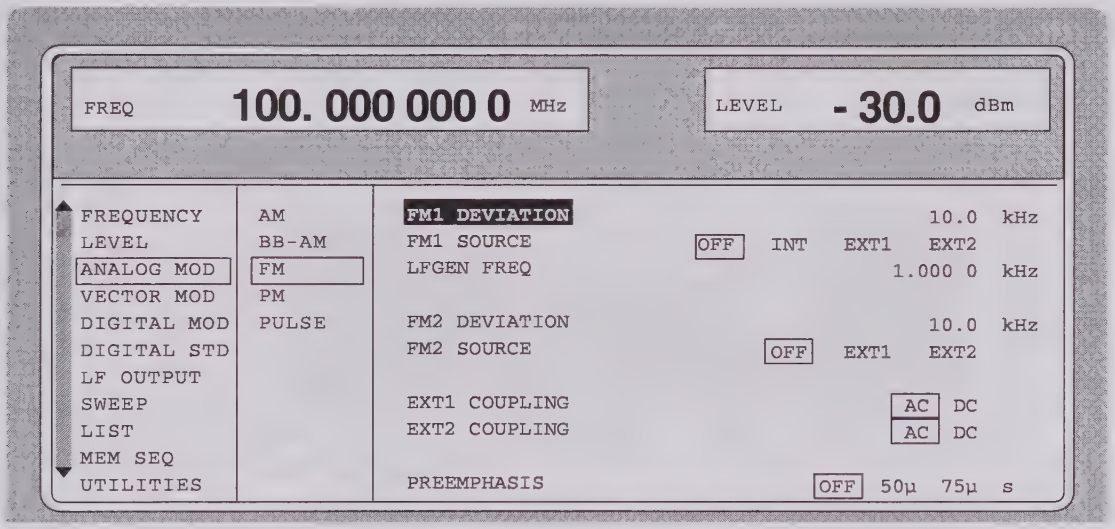
INPUT SENSITIVITY Display of the input sensitivity. The value cannot be changed.

2.7.3 Frequency Modulation

Menu ANALOG MOD-FM offers access to settings for frequency modulation.

Note: *The FM and PM modulations cannot be set simultaneously and deactivate one another:*

Menu selection: ANALOG MOD-FM



```
FREQ   100. 000 000 0 MHz                    LEVEL   - 30.0  dBm

FREQUENCY     AM       FM1 DEVIATION                          10.0   kHz
LEVEL         BB-AM    FM1 SOURCE           OFF  INT   EXT1   EXT2
ANALOG MOD    FM       LFGEN FREQ                           1.000 0  kHz
VECTOR MOD    PM
DIGITAL MOD   PULSE    FM2 DEVIATION                          10.0   kHz
DIGITAL STD            FM2 SOURCE                OFF   EXT1   EXT2
LF OUTPUT
SWEEP                  EXT1 COUPLING                    AC    DC
LIST                   EXT2 COUPLING                    AC    DC
MEM SEQ
UTILITIES              PREEMPHASIS                 OFF  50µ   75µ    s
```

Fig. 2-28 Menu ANALOG MOD-FM (preset setting), fitted with option SM-B5, FM/PM-modulator

FM1 DEVIATION	Input value of the deviation for FM1. IEC/IEEE-bus command	`SOUR:FM1 10kHz`
FM1 SOURCE	Switching on and off FM1 and selection of the modulation source. IEC/IEEE-bus command	`SOUR:FM1:SOUR INT; STAT ON`
LFGEN FREQ	Input value of the frequency of the LF generator. EC-bus short command	`SOUR:FM1:INT:FREQ 1kHz`
FM2 DEVIATION	Input value of the deviation for FM2. EC-bus short command	`SOUR:FM2 10kHz`
FM2 SOURCE	Switching on and off FM2 and selection of the modulation source. EC-bus short command	`SOUR:FM2:STAT OFF`
EXT1 COUPLING	Selection of the type of coupling AC or DC for the external input EXT1. IEC/IEEE-bus command	`SOUR:FM1:EXT1:COUP AC`
EXT2 COUPLING	Selection of the type of coupling AC or DC for the external input EXT2. IEC/IEEE-bus command	`SOUR:FM1:EXT2:COUP AC`
PREEMPHASIS	Selection of the preemphasis IEC-bus short command	`SOUR:FM1:PRE 50us`

2.7.3.1 FM Deviation Limits

The maximal deviation depends on the RF frequency set (cf.Fig. 2-29). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

In the RF range 450 MHz to 750 MHz and 1200 MHz to 1500 MHz a different synthesis range is selected depending on the deviation set. If the deviation is smaller than 500 kHz or 1000 kHz, the synthesizer is in the normal mode with optimal spectral purity. If the deviation set is larger the I/Q mode is automatically selected.

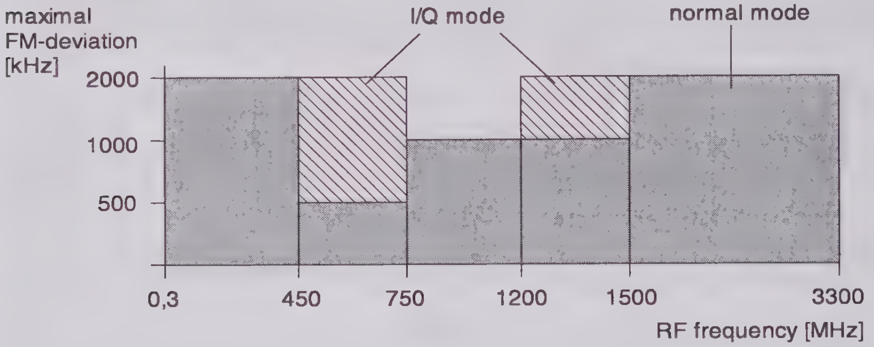


Fig. 2-29 Dependency of the FM maximal deviation on the RF frequency set

2.7.3.2 Preemphasis

Preemphasis results in a preemphasis of the modulation signal with time constants 50 µs or 75 µs. The higher frequencies of the modulation signal are preemphasized.

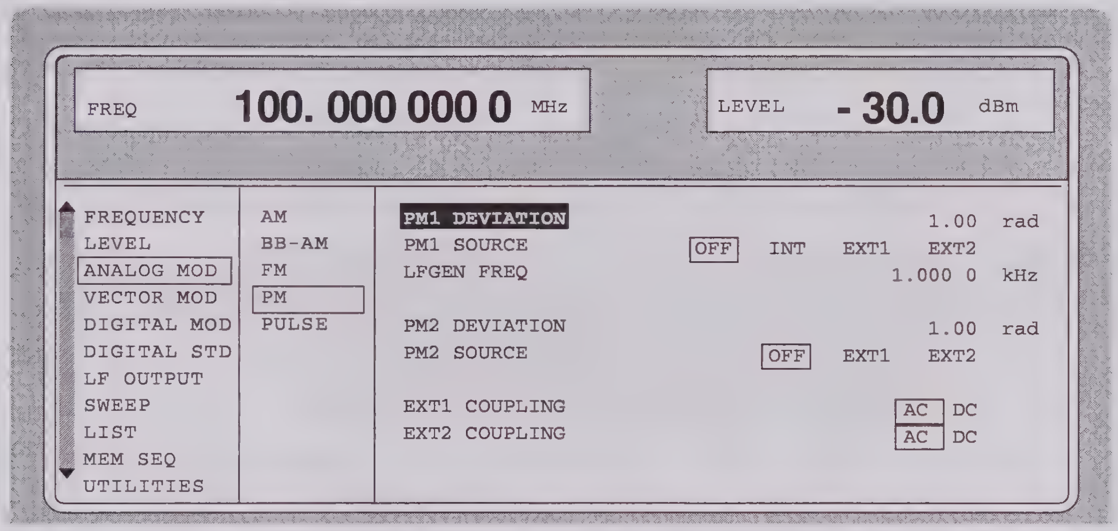
When preemphasis is switched on, only 1/4 of the maximal deviation is permissible. The highest permissible modulation frequency is 15 kHz. Exceeding the permissible modulation frequency can lead to overmodulation."

2.7.4 Phase Modulation

Menu ANALOG MOD-PM offers access to settings for phase modulation.

Note: *The PM and FM modulations cannot be set simultaneously and deactivate one another.*

Menu selection: ANALOG MOD - PM



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

PM1 DEVIATION 1.00 rad
PM1 SOURCE OFF INT EXT1 EXT2
LFGEN FREQ 1.000 0 kHz

PM2 DEVIATION 1.00 rad
PM2 SOURCE OFF EXT1 EXT2

EXT1 COUPLING AC DC
EXT2 COUPLING AC DC

Fig. 2-30 Menu ANALOG MOD - PM (preset setting), fitted with option SM-B5, FM/PM-modulator

PM1 DEVIATION	Input value of the deviation for PM1. IEC/IEEE-bus command `SOUR:PM1 1RAD`
PM1 SOURCE	Switching on and off PM1 and selection of the modulation source. IEC/IEEE-bus command `SOUR:PM1:SOUR:INT; STAT ON`
LFGEN1 FREQ	Input value of the frequency of the LF generator. IEC/IEEE-bus command `SOUR:PM1:INT:FREQ 1kHz`
PM2 DEVIATION	Input value of the deviation for PM2. IEC/IEEE-bus command `SOUR:PM2 1RAD`
PM2 SOURCE	Switching on and off PM2 and selection of the modulation source. IEC/IEEE-bus command `SOUR:PM2:SOUR INT; STAT ON`
EXT1 COUPLING	Selection of the type of coupling AC or DC with external supply for PM1 (input EXT1). IEC/IEEE-bus command `SOUR:PM:EXT1:COUP AC`
EXT2 COUPLING	Selection of the type of coupling AC or DC with external supply for PM2 (input EXT2). IEC/IEEE-bus command `SOUR:PM:EXT2:COUP AC`

2.7.4.1 PM Deviation Limits

The maximal deviation depends on the RF frequency set (cf. Fig. 2-31). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message displayed.

In the RF range 450 to 750 MHz and 1200 MHz to 1500 MHz a different synthesis range is selected depending on the deviation set. If the deviation is smaller than 5 rad or 10 rad, the synthesizer is in the normal mode with optimal spectral purity. If the deviation set is larger, the I/Q mode is automatically selected.

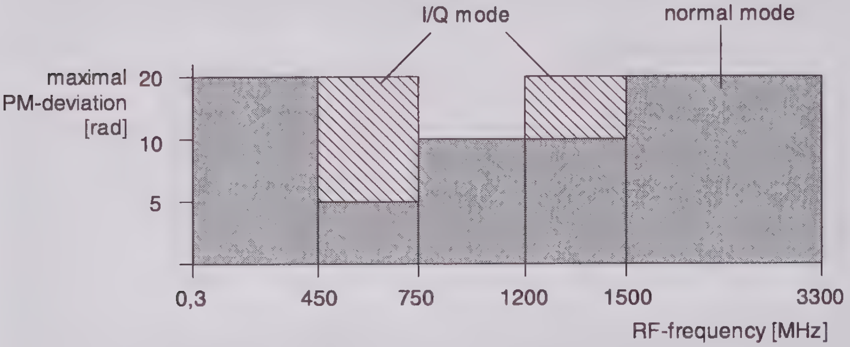


Fig. 2-31 Dependency of the PM maximal deviation on the RF frequency set

2.7.5 Pulse Modulation

The pulse modulator can be controlled by an external source at the PULSE input (AUX IN/OUT at the rear of the instrument).

The polarity of the pulse modulation is selectable. With POLARITY = NORM, the RF level is on with HIGH level at modulation input PULSE.

Menu MODULATION-PULSE offers access to settings for pulse modulation

Menu selection: MODULATION - PULSE

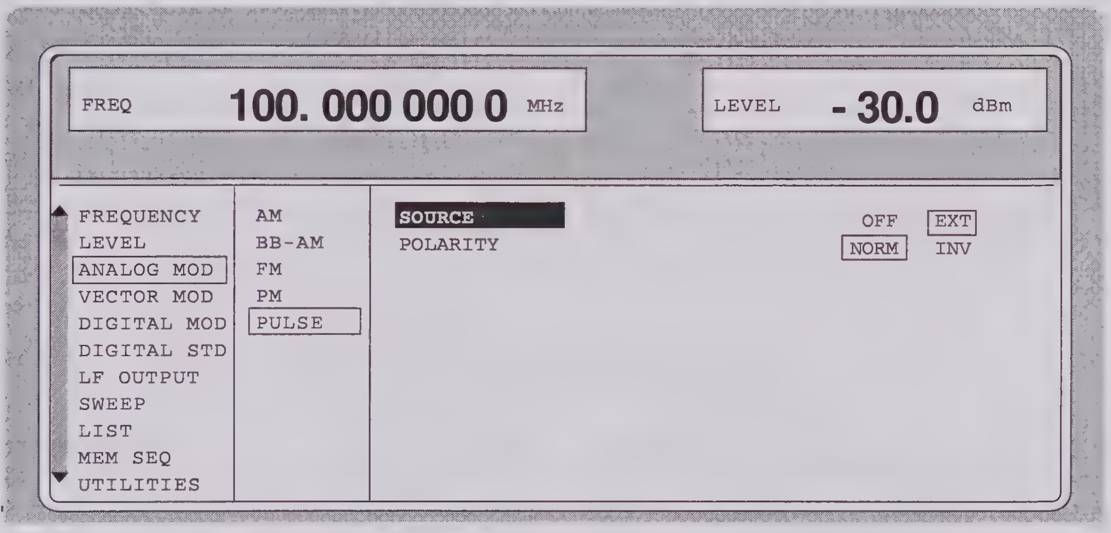

FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
SOURCE OFF [✓ EXT]
POLARITY [✓ NORM] INV

Fig. 2-32 Menu MODULATION-PULSE (preset setting), fitted with option SM-B3, pulse modulator, and option SM-B4, pulse generator

SOURCE	Switching on or off the external pulse modulation. IEC/IEEE-bus command `:SOUR:PULM:SOUR EXT; STAT ON`
POLARITY	Selection of the polarity of the modulation NORM The RF signal is on during high level. INV The RF signal is suppressed during high level. IEC/IEEE-bus command `:SOUR:PULM:POL NORM`

2.8 Vector Modulation

In the vector modulation mode (I/Q modulation) external modulation signals can be applied to modulation inputs I and Q for a complex modulation of the RF carrier.

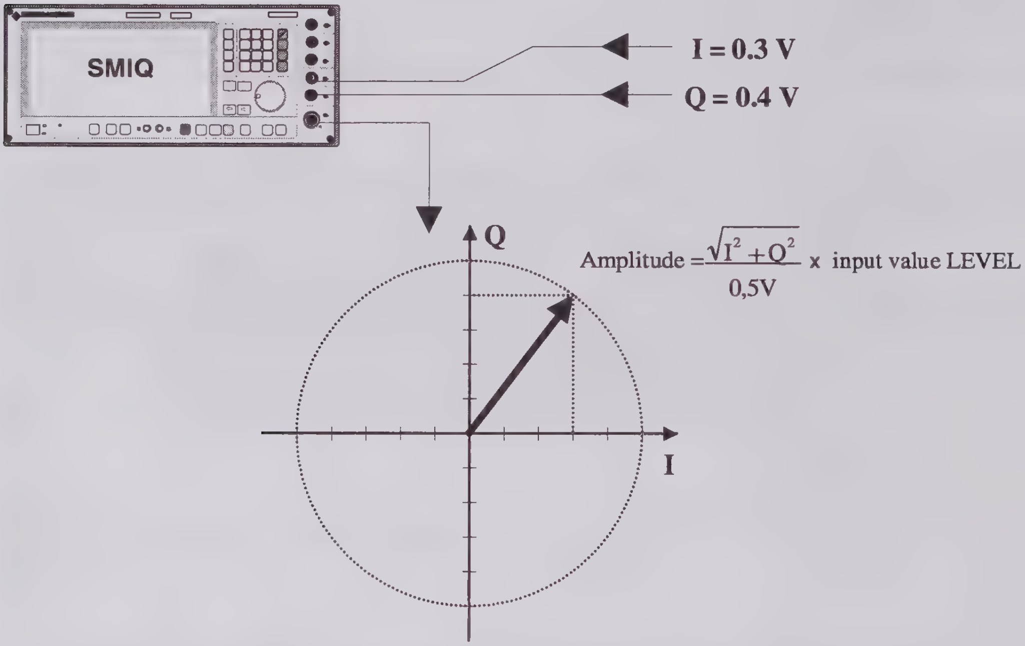

SMIQ
I = 0.3 V
Q = 0.4 V
Q
Amplitude = $\frac{\sqrt{I^2+Q^2}}{0,5V}$ x input value LEVEL
I

Fig. 2-33 Example: vector modulation

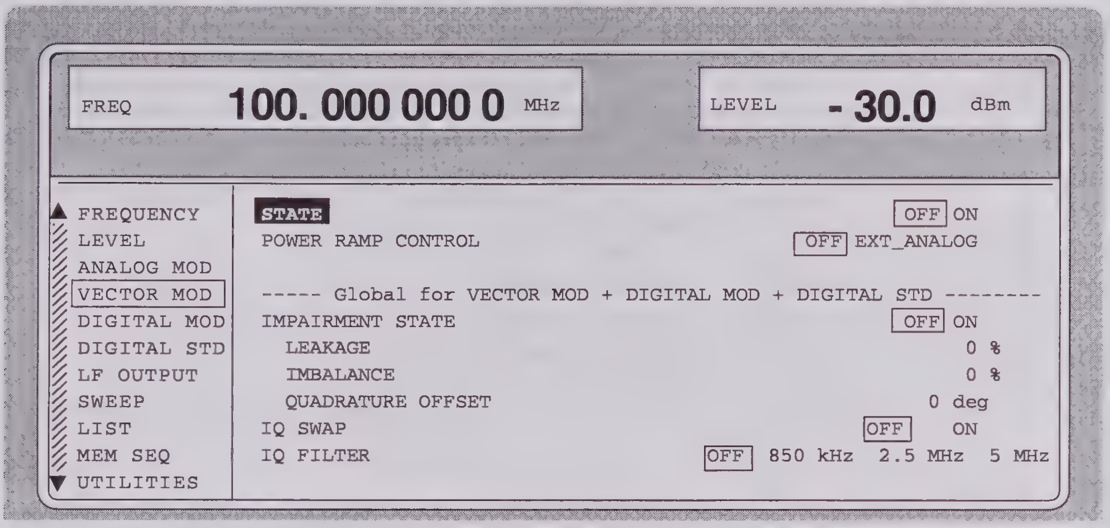
If the I/Q modulator is driven by a constant sum vector modulation of $\sqrt{I^2+Q^2} = 0.5V$ the actual RF level corresponds to the displayed RF level. To avoid the I/Q modulator being overdriven, care should be taken that the sum vector never exceeds 0.5 V when digital modulation modes with amplitude modulation components such as QPSK are used. For full-scale input, the peak envelope power of the modulated RF signal is thus equal to the indicated LEVEL. The average power is smaller. The difference can be entered as an offset in the LEVEL menu.

Vector modulation settings are accessible in the VECTOR MOD menu, see following page.

Note:

- *Types of modulation VECTOR MOD and BB-AM cannot be set at the same time; they switch each other off.*
- *A selectable internal calibration of the I/Q modulator allows accurate and reproducible measurements to be made. The calibration routine should be called up with the CALIBRATE ▶ in the menu VECTOR MOD or UTILITIES-CALIB-VECTOR MOD after temperature changes of more than 5° C.*

Menu selection: VECTOR MOD



```
FREQ    100. 000 000 0  MHz                    LEVEL    - 30.0   dBm

▲ FREQUENCY     STATE                                            OFF ON
  LEVEL         POWER RAMP CONTROL                       OFF EXT_ANALOG
  ANALOG MOD
  VECTOR MOD    ----- Global for VECTOR MOD + DIGITAL MOD + DIGITAL STD --------
  DIGITAL MOD   IMPAIRMENT STATE                                 OFF ON
  DIGITAL STD     LEAKAGE                                           0 %
  LF OUTPUT       IMBALANCE                                         0 %
  SWEEP           QUADRATURE OFFSET                               0 deg
  LIST          IQ SWAP                                        OFF    ON
  MEM SEQ       IQ FILTER                       OFF  850 kHz  2.5 MHz  5 MHz
▼ UTILITIES
```

Fig. 2-34 VECTOR MOD menu (preset settings), equipped with option SMIQB47 and IQMOD var. 8 or higher

STATE

Switches the vector modulation on and off.

IEC/IEEE-bus command `SOUR:DM:IQ:STAT ON`

POWER RAMP CONTROL

Switches the POW RAMP input for analog level control on and off. Thus an external control signal can be used for carrier envelope modulation in parallel to vector modulation..

IEC/IEEE-bus command `SOUR:DM:IQ:PRAM AEXT`

IMPAIRMENT STATE

Switches I/Q impairment on and off.

IEC/IEEE-bus command `SOUR:DM:IQ:IMP:STAT ON`

LEAKAGE

Value entered for residual carrier .

IEC/IEEE-bus command `SOUR:DM:LEAK 10PCT`

IMBALANCE

Value entered for imbalanced modulation of I and Q vectors.

IEC/IEEE-bus command `SOUR:DM:IQR -5PCT`

QUADRATURE OFFSET

Value entered for quadrature offset .

IEC/IEEE-bus command `SOUR:DM:QUAD:ANGL 4DEG`

IQ SWAP

Selection between normal and inverted I/Q modulation. Interchanging the I and Q signals inverts the modulation sidebands.

OFF	Normal I/Q modulation.
ON	I and Q signals interchanged.

IEC/IEEE-bus command `SOUR:DM:IQSW:STAT ON`

IQ FILTER

Only available with option SMIQB47.
Selection between no filter and a 850 kHz, a 2.5 MHz or a 5 MHz lowpass in the baseband. A filter of these types suppresses noise in the baseband above 900 kHz, 3 MHz or 6 MHz, which improves ACP (Adjacent Channel Power) for IS95 and W-CDMA. The frequency response of the filter is automatically compensated for DIGITAL MOD and DIGITAL STD in MCOD, which means that the EVM (Error Vector Magnitude) gets hardly worse. For VECTOR MOD and AMIQ with WinIQSIM as source, the frequency response is also compensated in WinIQSIM. For applications requiring a minimum EVM, the IQ filter should be set to OFF.

OFF	no filter
850 kHz	850 kHz lowpass
2.5 MHz	2.5 MHz lowpass
5 MHz	5 MHz lowpass

IEC/IEEE-bus commands

```
:SOUR:DM:IQ:FILT:STAT ON|OFF
:SOUR:DM:IQ:FILT:FREQ 2.5MHZ
```

2.8.1 I/Q Impairment

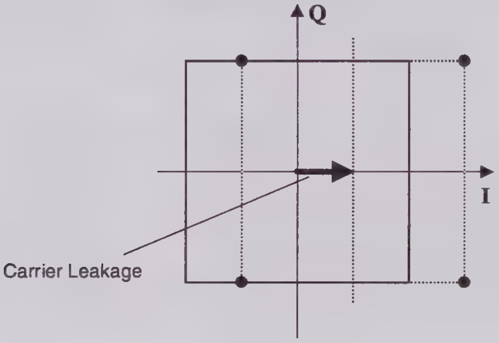
For simulating an impairment of the vector modulation, a residual carrier (LEAKAGE), imbalanced I and Q modulation (IMBALANCE) and a quadrature offset can be entered. The input values for LEAKAGE and IMBALANCE are with reference to the voltage.

Table 2-3 Parameter setting ranges

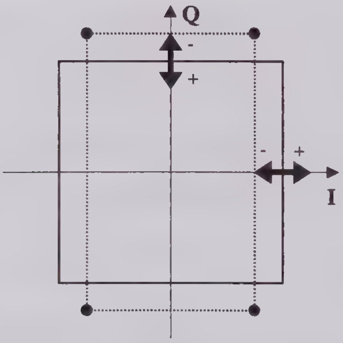
Parameter	**Setting range**	**Resolution**
LEAKAGE	0 ... 50 %	0.5 %
IMBALANCE	-12 ... +12 %	0.1 %
QUADRATURE OFFSET	-10 ... +10°	0.1°

The following figure shows the effect of I/Q impairment.

LEAKAGE:



IMBALANCE:



QUADRATURE OFFSET:

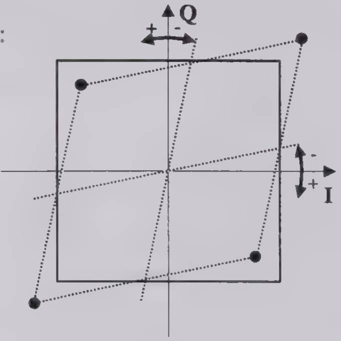


Fig. 2-35 Effect of I/Q impairment

2.9 Fading Simulation

By means of the option Fading Simulator SMIQB14, multipath fading signals with 6 independent transmission paths can be generated.

Important: **The Fading Simulator can only be operated with the complex baseband signals I and Q. Therefore, it is necessary to switch on either Vector Modulation or Digital Modulation.**

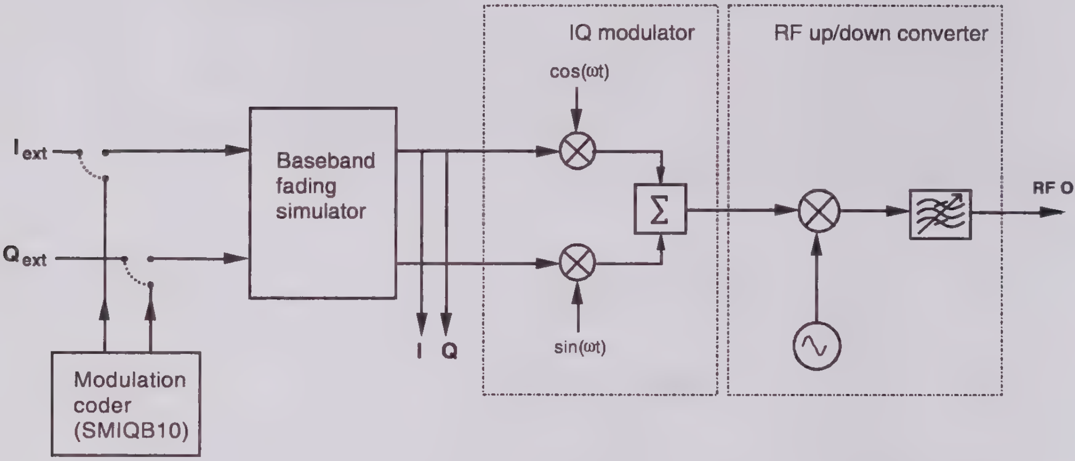


Fig. 2-36 Fading simulator in the SMIQ

The input signals for the fading simulator can either be applied to the modulation inputs I and Q or will be generated in the SMIQ by the optional Modulation Coder (SMIQB20). The output signals of the fading simulator will be passed to the IQ Modulator and then be mixed to the RF.

SMIQ can also be equipped with two Fading Simulators (SMIQB14 and SMIQB15). The second fading option provides another 6 transmission paths.
If only one fading simulator is built in, output signals I and Q are available at the I FADED and Q FADED connectors.
If two fading simulators are built in, the sum signal of the two fading options with 12 fading paths are available at the I FADED and Q FADED connectors.

Note: *A selectable internal calibration of the fading simulator allows internal compensation of DC offset voltages. The calibration routine should be called up after temperature changes of more than 5 degree in menu UTILITIES-CALIB-VECTOR MOD.*

2.9.1 Output Power with Fading

With a PATH LOSS setting of 0 dB, a single path of the fading simulator introduces an insertion loss between 12 dB and 18 dB for the IQ signals applied (with Insertion Loss Setting Mode = NORMAL). This insertion loss provides a headroom if several paths are superimposed on one another and also for the statistical influences to which a path is exposed. In the LOW ACP mode, the insertion loss is reduced to approx. 6 dB to 12 dB. This may lead to the rare case of clipping level being attained in the instrument. The IQ signals are in such case limited to the maximum level (clipping). The corresponding insertion loss is automatically corrected in the SMIQ. The output power is kept constant.

Displays:

LEVEL:	The rms value of the output signal is displayed.
PEP:	The (theoretically possible) peak value is displayed. This value is attained if clipping level is reached both for the I and the Q path. For signals with a high crest factor it is not likely that the PEP value is attained.

Due to the insertion loss introduced by the fading simulator, the maximum output power of the SMIQ is reduced by max. 18 dB.

2.9.2 Two-Channel Fading

For two-channel fading, an SMIQ with two fading options (SMIQB14 and SMIQB15) and a second SMIQ without fading options is required. Moreover, the SMIQ has to be recabled internally, see description in Chapter 1, Section "Option SMIQB15 – Second Fading Simulator". After reconnecting the internal cables, the I/Q baseband signals of the second channel (SMIQB15) are available at connectors I FADED and Q FADED on the rear panel of the unit. On the second unit, vector modulation has to be switched on.

Note: *Because of the insertion loss introduced by the fading simulator in the first SMIQ, the second SMIQ is not driven correctly. For the second SMIQ to be driven correctly, the current insertion loss of the first SMIQ must be determined and entered into the second SMIQ. This correction can be made by entering a CREST FACTOR in the vector modulation menu of the second SMIQ. The numerical value to be entered can be taken from the first SMIQ from the line SET SECOND SMIQ CREST FACTOR TO in the fading menu. After this value has been entered, the second SMIQ supplies the output level indicated in the menu.*

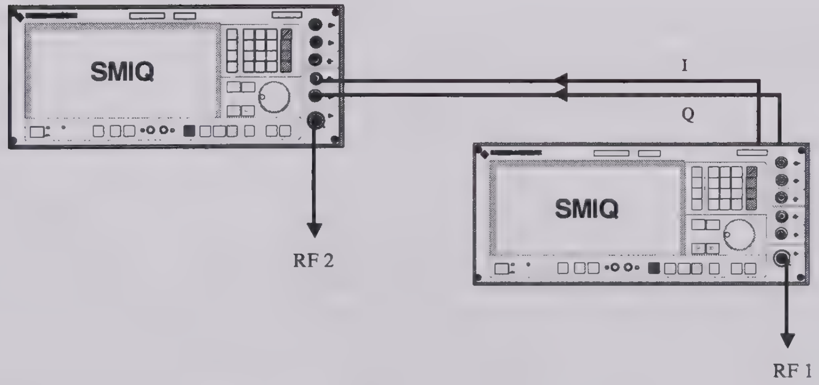


Fig. 2-37 Two-channel fading

2.9.3 Correlation between Paths

Fading processes of different paths normally do not depend on statistical processes. However, it is possible to set a correlation of paths 1 to 6 with paths 7 to 12 in pairs. To set the correlation, a synchronous signal processing is required for the two fading options which involves the following restrictions:

- The correlation is always reciprocal, ie if path 1 is correlated with path 7, path 7 is also correlated with path 1 (CORR PATH).
- The following parameters of the two paths have to correspond:

- Fading profile PROFILE

- Doppler parameter SPEED or DOPPLER FREQ

- Magnitude of correlation coefficient COEFF

- The following equation applies to the phase of the correlation coefficient and thus to the phase shift between the correlated paths:

$$\varphi_{12} = 360° - \varphi_{21}$$

- The parameters for Log Normal fading have to correspond for correlated paths.

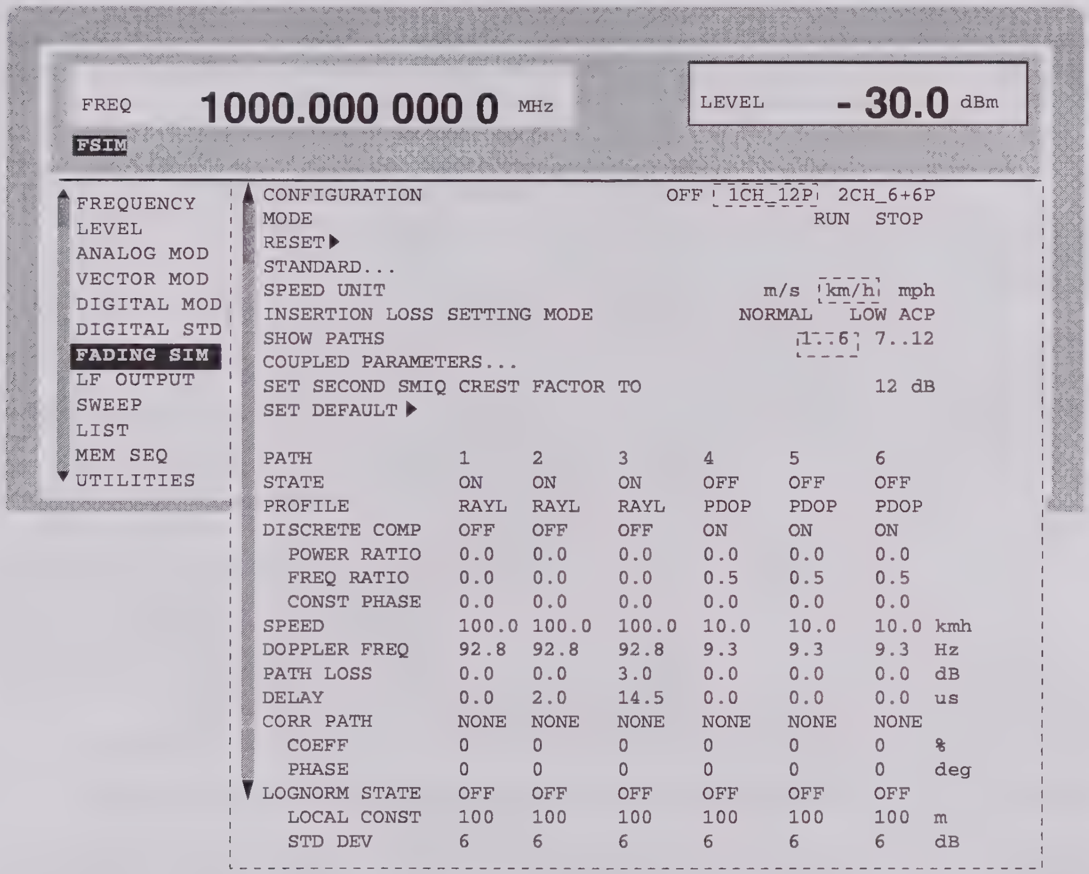
All parameter adaptations due to the limitations mentioned before are automatically performed by SMIQ.

Note: *After setting all parameters, the two fading options have to be synchronized by RESET and then by RUN.*

2.9.4 Fading Simulation Menu

Fading simulation settings are accessible in the FADING SIM menu.

Menu selection: FADING SIM



```
FREQ   1000.000 000 0 MHz                LEVEL   - 30.0 dBm

CONFIGURATION                             OFF  1CH_12P  2CH_6+6P
MODE                                               RUN   STOP
RESET▶
STANDARD...
SPEED UNIT                                     m/s  km/h  mph
INSERTION LOSS SETTING MODE                 NORMAL   LOW ACP
SHOW PATHS                                        1..6  7..12
COUPLED PARAMETERS...
SET SECOND SMIQ CREST FACTOR TO                         12 dB
SET DEFAULT▶

PATH            1      2      3      4      5      6
STATE           ON     ON     ON     OFF    OFF    OFF
PROFILE         RAYL   RAYL   RAYL   PDOP   PDOP   PDOP
DISCRETE COMP   OFF    OFF    OFF    ON     ON     ON
  POWER RATIO   0.0    0.0    0.0    0.0    0.0    0.0
  FREQ RATIO    0.0    0.0    0.0    0.5    0.5    0.5
  CONST PHASE   0.0    0.0    0.0    0.0    0.0    0.0
SPEED           100.0  100.0  100.0  10.0   10.0   10.0  kmh
DOPPLER FREQ    92.8   92.8   92.8   9.3    9.3    9.3   Hz
PATH LOSS       0.0    0.0    3.0    0.0    0.0    0.0   dB
DELAY           0.0    2.0    14.5   0.0    0.0    0.0   us
CORR PATH       NONE   NONE   NONE   NONE   NONE   NONE
  COEFF         0      0      0      0      0      0     %
  PHASE         0      0      0      0      0      0     deg
LOGNORM STATE   OFF    OFF    OFF    OFF    OFF    OFF
  LOCAL CONST   100    100    100    100    100    100   m
  STD DEV       6      6      6      6      6      6     dB
```

Fig. 2-38 Menu FADING SIM (two fading simulators installed)

CONFIGURATION Switching on fading simulation by selection of the number of active paths and channels.

1CH_6P	One channel with 6 paths (with option SMIQB14)
1CH_12P	One channel with 12 paths (with SMIQB14 and SMIQB15)
2CH_6+6	Two channels with 6 paths each (with SMIQB14 and SMIQB15)

IEC\IEEE-bus command `SOUR:FSIM:CONF S12P`
`SOUR:FSIM ON`

MODE Stopping (STOP) and starting (RUN) the fading process.

Following RESET the mode RUN starts the Pseudo Noise Generator at a defined starting point for generating the fading process.

IEC\IEEE-bus command `SOUR:FSIM:SEQ RUN`

RESET ▶

Resetting the Pseudo Noise Generator.
If RESET is set, the parameter MODE is automatically set to STOP. RESET also ensures a synchronization of the two fading options during 2-channel mode with the correlation switched on.

IEC\IEEE-bus command `:SOUR:FSIM:SEQ:RES`

STANDARD

Opens a window for selecting a standard setting of the fading paths. The parameter settings comply with the measurement specifications of mobile communication standards (e.g. GSM, CDMA, NADC).

With standards TETRA TYPICAL URBAN and TETRA HILLY TERRAIN, all 6 paths are used with these parameters instead of the stipulated 2 paths. This yields an improved residual carrier with the same output signal.

IEC\IEEE-bus command `SOUR:FSIM:STAN CDMA100`

SPEED UNIT

Selection of the speed unit.

IEC\IEEE-bus command `:SOUR:FSIM:SPE:UNIT KMPH`

INSERTION LOSS SETTING MODE

Selection of setting mode for the insertion loss of the fading simulator.

NORMAL The minimum insertion loss for a path of the fading simulator is fixed to 18 dB. The value has been chosen so that even with Log Normal-Fading switched on, the fading simulator will seldom be overdriven. This setting should be chosen for BER measurements.

IEC/IEEE-bus command `:SOUR:FSIM:ILOS:MODE NORM`

LOW_ACP The minimum insertion loss is between 6 and 12 dB. The value depends on the PATH LOSS setting of the selected paths. This mode is ideal for all STANDARD menu settings regarding signal/noise ratio and residual carrier suppression. This setting should be chosen for measurements which involve an adjacent-channel interfering signal generated by the SMIQ.

IEC/IEEE-bus command `:SOUR:FSIM:ILOS:MODE LACP`

SHOW PATHS

Switching from the display of paths 1 to 6 to the display of paths 7 to 12.

COUPLED PARAMETERS...

In this submenu, parameters SPEED, COEFF, LOCAL CONST and STD DEV can be coupled via the ON setting. If one of these parameters is modified afterwards in a particular path, the parameters of all other paths will be modified.

SPEED SETTING COUPLED
ON Parameters coupled for all paths.
OFF Parameter can be set individually.
IEC/IEEE `:SOUR:FSIM:COUP:SPE ON`

CORR COEFF SETTING COUPLED
ON Parameters coupled for all paths.
OFF Parameter can be set individually.
IEC/IEEE `:SOUR:FSIM:COUP:CORR:COEF ON`

LOCAL CONST SETTING COUPLED
ON Parameters coupled for all paths.
OFF Parameter can be set individually.
IEC/IEEE `:SOUR:FSIM:LOGN:LCON ON`

STD DEV SETTING COUPLED
ON Parameters coupled for all paths.
OFF Parameter can be set individually.
IEC/IEEE `:SOUR:FSIM:LOGN:CSTD ON`

SET SECOND SMIQ CREST FACTOR TO

Indication of crest factor which has to be set on the second SMIQ in the vector modulation menu so that the insertion loss caused by the fading simulator (in the first SMIQ) is compensated correctly on the second SMIQ.

IEC/IEEE-bus command `:SOUR:FSIM:CFAC:EXT?`

SET DEFAULT ▶ Default setting of path parameter with path 1 switched on and all other paths switched off.

IEC\IEEE-bus command `:SOUR:FSIM:DEF`

PATH The following parameter have to be set separately for each path.

STATE Switching on and off a path. If the cursor is placed onto a path in the diagram, it may be switched on and off by pressing one of the unit keys (toggle function).

IEC\IEEE-bus command `:SOUR:FSIM:PATH3:STAT ON`

PROFILE Selection of the fading profile.

pDOPP (Pure DOPpler) Simulation of a transmission path having a single direct connection from the transmitter to the moving receiver (discrete component). The Doppler Frequency shift is determined by the parameters DOPPLER FREQ and FREQ RATIO.

IEC\IEEE-bus command `:SOUR:FSIM:PATH4:PROF PDOP`

RAYL (RAYLeigh) Simulation of a radio field, where a multitude of broadly scattered partial waves hit upon a moving receiver. The receiving amplitude resulting therefrom is time-varying. The probability density function of the receiving amplitude is described by a Rayleigh distribution. The fading spectrum is a classical Doppler spectrum.

IEC\IEEE-bus command `:SOUR:FSIM:PATH1:PROF RAYL`

RICE Simulation of a radio field, where apart from a multitude of scattered partial waves, one strong direct wave (discrete component) hits upon a moving receiver. The probability density function of the receiving amplitude is described by a Rice distribution. The fading spectrum of an unmodulated signal is an overlapping of a classical Doppler spectrum with a discrete spectrum line.

IEC\IEEE-bus command `:SOUR:FSIM:PATH7:PROF RICE`

CPHAS A radio traffic area without direct and random waves is generated for this fading type (no discrete and no static component). The path is multiplied by a constant "pointer“ according to the path-specific parameter.

IEC/IEEE-bus command `:SOUR:FSIM:PATH3:PROF CPH`

DISCRETE COMP Shows the status of the discrete component (ON or OFF).

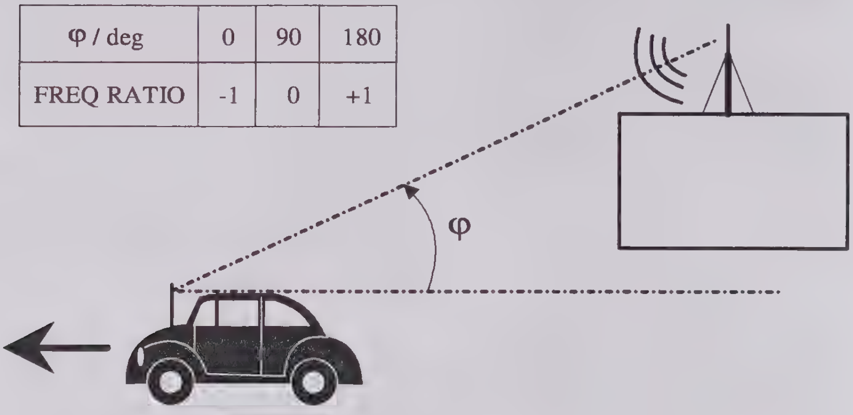
IEC\IEEE-bus command `:SOUR:FSIM:PATH4:DCOM:STAT ON`

POWER RATIO Input value of the power ratio of the discrete component and distributed component with Ricean fading switched on. If POWER RATIO is changed the sum of both components remains constant.

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:PRAT 3`

FREQ RATIO Input value of the ratio of the actual Doppler Frequency shift to the Doppler Frequency setting with Ricean fading or Pure Doppler switched on. The actual Doppler Frequency shift depends on the simulated angle of incidence of the discrete component.

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:FRAT 1`



φ / deg	0	90	180
FREQ RATIO	-1	0	+1

Fig. 2-39 Doppler Frequency shift with moving receiver

CONST PHASE Entry value of CONST PHASE with CPHAS fading switched on. The corresponding path is multiplied by this phase.

IEC/IEEE-bus command `:SOUR:FSIM:PATH6:CPH 20.0`

SPEED Input value of the speed v of the moving receiver.

The Doppler frequency f_D (DOPPLER FREQ) is calculated from the speed and the RF frequency f_{RF}. When changing SPEED the parameter DOPPLER FREQ will be automatically adjusted. This parameter can be coupled, see parameter COUPLED PARAMETERS...

Range: $v_{min} = \frac{0.03 \cdot 10^9 \, m/s^2}{f_{RF}}$ $v_{max} = \frac{479 \cdot 10^9 \, m/s^2}{f_{RF}}$

$$v_{max} \leq 99999 \, km/h$$

IEC\IEEE-bus command `:SOUR:FSIM:PATH1:SPE 100`

DOPPLER FREQ Input value of the amount of the maximum Doppler Frequency shift (cf. FREQ RATIO).

When changing the Doppler Frequency f_D the parameter SPEED will be automatically adjusted.

With $c = 2.998 \cdot 10^8 \, m/s$ it is $\frac{v}{c} = \frac{f_D}{f_{RF}}$

IEC\IEEE-bus command `:SOUR:FSIM:PATH2:FDOP 92.3`

PATH LOSS Input value of the attenuation of the path.

IEC\IEEE-bus command `:SOUR:FSIM:PATH3:LOSS 3`

DELAY Input value of the signal delay in the path.

IEC\IEEE-bus command `:SOUR:FSIM:PATH3:DEL 14.5`

CORR PATH

Switching on or off (NONE) a correlation with the selected path. This setting is accessible if both fading options SMIQB14 and SMIQB15 have been installed. Only a two by two correlation of paths 1 to 6 with paths 7 to 12 can be set.

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:CORR:PATH 12`

COEFF

Input value of the amplitude of the complex correlation coefficient. This parameter can be coupled, see parameter COUPLED PARAMETERS...

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:CORR:COEF 0.5`

PHASE

Input value of the phase of the complex correlation coefficient.

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:CORR:PHAS 180`

LOGNORM STATE

Switching on or off the Log Normal-Fading.

With Log Normal-Fading set, an additional rather slow continuous changing of the receiving amplitude of a moving receiver is simulated. Log Normal-Fading has a multiplying effect on the path loss. The multiplication factor is time-varying and logarithmically normally distributed. If a Rayleigh profile is set simultaneously, this results in Suzuki-Fading.

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:LOGN:STAT ON`

LOCAL CONST

Input value of the area constant L. This parameter can be coupled, see parameter COUPLED PARAMETERS...

The area constant L and the speed v of the moving receiver determine the corner frequency f_L of Log Normal-Fading:

$$f_L = v / L$$

The power density spectrum of an unmodulated carrier (CW) is an overlapping of a discrete spectrum line at f_{RF} with a frequency dependent continuous spectrum described by

$$S(f) = \mathrm{const} \cdot e^{-0.5 \cdot \left(\frac{f - f_{RF}}{f_L} \right)^2}$$

The lower limit of the range is dependent on the RF frequency f_{RF} :

$$L_{min} = \frac{12 \cdot 10^9 \, \mathrm{m/s}}{f_{RF}}$$

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:LOGN:LCON 150`

STD DEV

Input value of the standard deviation of the Log Normal-Fading. This parameter can be coupled, see parameter COUPLED PARAMETERS...

IEC\IEEE-bus command `:SOUR:FSIM:PATH6:LOGN:CSTD 6`

2.10 Digital Modulation

With option Modulation Coder (MCOD) SMIQB20 provided, SMIQ can generate digitally modulated output signals. Available modulation methods are ASK (amplitude shift keying), FSK (frequency shift keying), PSK (phase shift keying) as well as QAM (quadrature amplitude modulation). Baseband filtering and symbol rate can be freely set in a wide range.
The modulation coder generates the analog IQ signals for the I/Q modulator of SMIQ from the digital input signals.

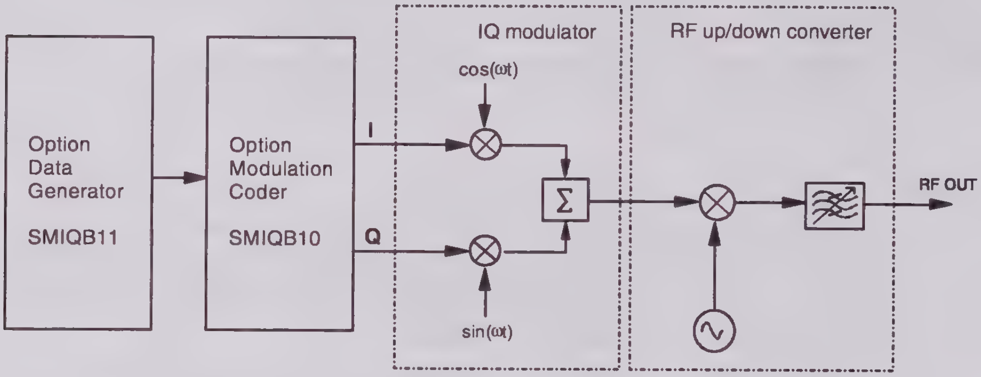


Fig. 2-40 Modulation coder in SMIQ

The modulation coder works with digital input signals such as

- clock signals (symbol clock, bit clock),
- modulation data or modulation symbols,
- control signals for envelope control and trigger signals.

The digital input signals may originate from the following sources:

- The modulation coder can generate clock signals such as PRBS data signals and simple data patterns.
- External clock signals, modulation data and signals for envelope control can be fed in via connectors at the front or rear panel of SMIQ.
- With option Data Generator SMIQB11 provided, an additional data source is available. This option has a 16-Mbit memory for modulation data and control signals. The memory can be extended to 48 Mbit or 80 Mbit by installing one or two SMIQB12 options (Memory Extension).

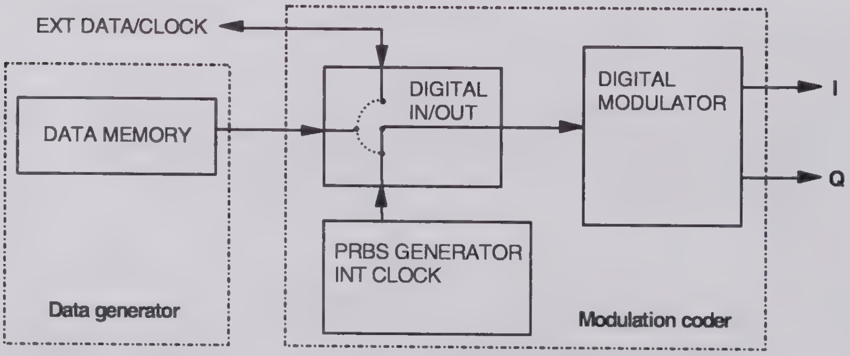


Fig. 2-41 Digital input signals of modulation coder

2.10.1 Digital Modulation Methods and Coding

The input sequence of modulation symbols d_n can be subject to different types of coding. I and Q values are assigned to the coded modulation symbols dc_n in the functional block MAPPING.

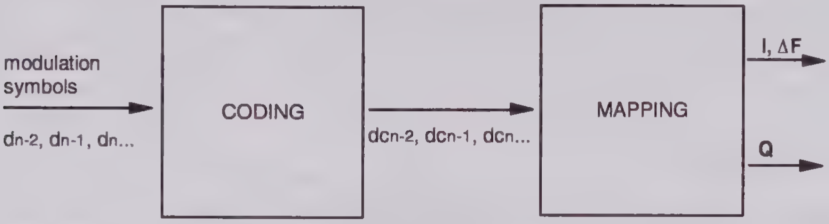


Fig. 2-42 Functional blocks Coding and Mapping

2.10.1.1 PSK and QAM Modulation

PSK and QAM modulations can be explained on the basis of a rule of assignment (mapping) according to which each modulation symbol is represented by I and Q values as shown in the following IQ constellation diagrams. The constellation diagrams apply if **no** coding is switched on.

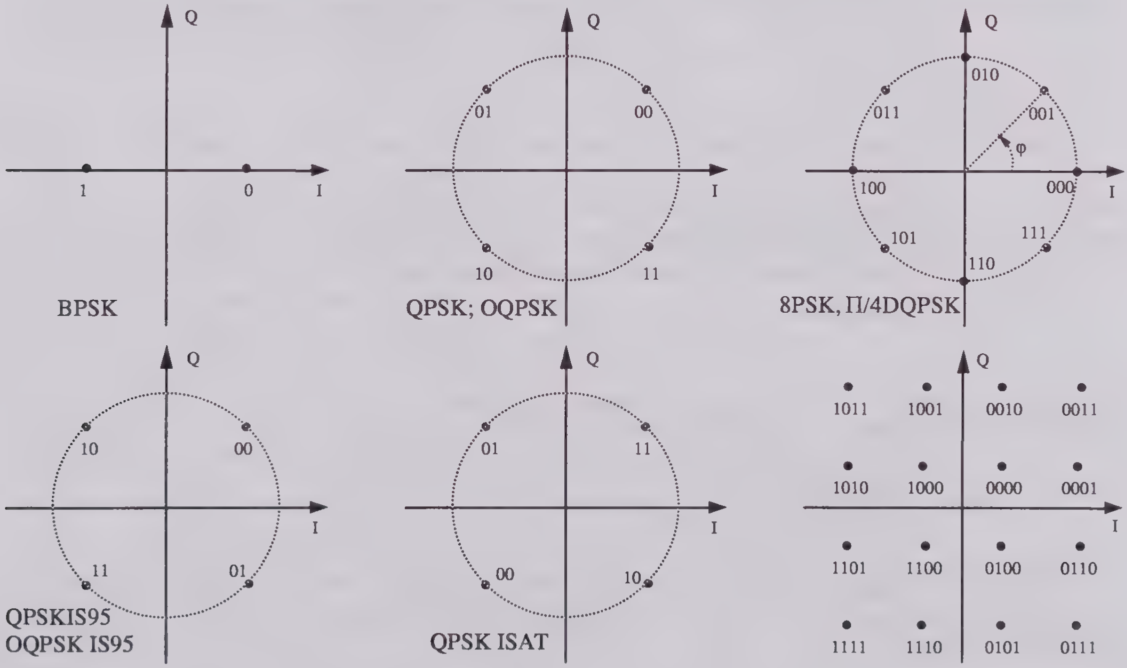


Fig. 2-43 Constellation diagrams of BPSK, QPSK, 8PSK and 16QAM

For offset QPSK (OQPSK), the Q signal is delayed by half the symbol period with reference to the I signal.
QAM modulation methods 16QAM, 32QAM, 64QAM and 256QAM were implemented according to ETSI standard ETS 300429 for Digital Video Broadcasting (DVB).
All PSK and QAM modulation methods can be combined with COS and SQR_COS baseband filters as well as with IS-95 filters. A combination with GAUSS and BESSEL filters is not possible.

2.10.1.2 Modulation π/4DQPSK

With differential coding switched on at the same time, a constellation diagram is obtained for π/4DQPSK which is similar to that obtained for 8PSK. Phase shifts are however assigned to the individual modulation symbols. The following tables show the assignment of modulation symbols to phase shifts of IQ vectors at the selected coding.

Table 2-4 Phase shifts for π/4DQPSK without coding

Modulation symbol d_n (binary indication: MSB, LSB)	00	01	10	11
Phase shift φ	+ 45°	+135°	-135°	-45°

Table 2-5 Phase shifts for π/4DQPSK with coding NADC, PDC, PHS, TETRA or APCO25

Modulation symbol d_n (binary display: MSB, LSB)	00	01	10	11
Phase shift φ	+ 45°	+135°	-45°	-135°

Table 2-6 Phase shifts for π/4DQPSK with coding TFTS

Modulation symbol d_n (binary display: MSB, LSB)	00	01	10	11
Phase shift φ	- 135°	+135°	-45°	+45°

2.10.1.3 FSK Modulation

For FSK modulation, frequency shifts are assigned to the modulation symbols. The modulation index h of this digital frequency modulation is determined by

$$h = 2 \cdot \Delta f \, / \, f_{Symb}$$

The symbol rate f_{SYMB} can be freely set to a maximum of 2.5 Msymb/s for all FSK modulations. With GMSK selected, the frequency deviation Δf (FSK deviation) cannot be set since the modulation index is fixed to a value of h = 0.5. The following table shows the assignment of modulation symbols and frequency deviations for the different FSK methods.

Table 2-7 Frequency deviations for FSK methods

Mod. symbol	2FSK, GFSK	MSK, GMSK	4FSK	APCO
0	$-\Delta f$	$-\Delta f$	$-\Delta f$	$+\Delta f/3$
1	$+\Delta f$	$+\Delta f$	$-\Delta f/3$	$+\Delta f$
10	-	-	$+\Delta f/3$	$-\Delta f/3$
11	-	-	$+\Delta f$	$-\Delta f$

All FSK modulation methods can be combined with COS, SQR_COS, GAUSS and BESSEL baseband filters. A combination with IS-95 filters is not permissible.

2.10.1.4 Coding

Modulation symbols are coded directly before an assignment of I and Q values or frequency shifts. Coding is thus directly related with modulation methods which is the reason why codings are not freely combinable with modulation methods. The following table shows which combinations are possible.

Table 2-8 Possible combination of modulation method and coding

Coding	Selection CODING	Combinable with MOD TYPE	Example of use
Differential coding	DIFF	all except for 256QAM	
Gray + differential coding	GRAY+DIFF	all except for 256QAM	D8PSK for VDR
GSM differential coding	GSM	FSK, GFSK, GMSK	Mobile radio standard GSM
π/4DQPSK differential coding	NADC; PDC;..	π/4DQPSK	Mobile radio standards NADC, PDC, PHS, APCO25, TFTS, TETRA
Phase differential coding	INMARSAT	QPSK ISAT	Satellite system INMARSAT-M
Phase differential coding	PHASE DIFF	16 , 32 , 64 , 256 QAM	DVB in line with ETS 300429
VDL coding	VDL	8PSK	VHF Digital Link

The effect of differential coding on π/4DQPSK has been described in section 'Modulation π/4DQPSK'. Common coding types are listed in the following table.

Table 2-9 Coding algorithms

CODING	Coding algorithm	Applicable for K bit/symbol
NONE	$dc_n = d_n$	K = 1 to 8
DIFF	$dc_n = (d_n + dc_{n-1})$ modulo 2k	K = 1 to 7
GRAY+DIFF	Gray coding with additional differential coding	K = 1 to 7
GSM	dc_n = not (d_n exor d_{n-1}	K = 1
VDL	VDL standard	K = 3

Example 1: Differential coding for QPSK modulation with K = 2 bit/symbol
Decimal display; value range for modulation symbols
$d_n \in \{0;1;2;3\}$

Recursive coding is defined as follows: $dc_n = (d_n + d_{cn}\text{-}1)$ modulo 4.

Depending on the state of a preceding modulation symbol dc_{n-1} the coded modulation symbol dc_n is obtained for example from a modulation symbol $d_n = 2$ as follows:

$d_n = 2$	dc_{n-1}	dc_n
	0	2
	1	3
	2	0
	3	1

By means of differential coding, the assignment between modulation symbols and phase differences shown in the following table is generated:

Modulation symbol d_n (binary, MSB, LSB)	00	01	10	11
Phase difference $\Delta\varphi$	0°	90°	180°	270°

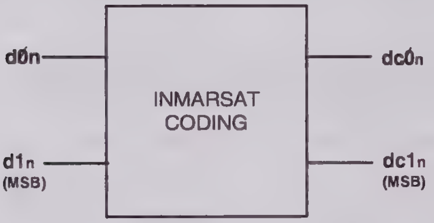
Example 2: Gray and differential coding for 8PSK modulation
First, a gray coding is performed according to the gray code. Afterwards, a differential coding is performed according to the recursive coding algorithm quoted above. By means of the mapping rule shown in the figure in Section 'PSK and QAM Modulation' above, IQ values are assigned to the re-coded modulation symbols. In summary, the assignment between modulation symbols and phase differences shown in the following table is generated:

Modulation symbol d_n (binary, MSB, LSB)	000	001	010	011	100	101	110	111
Phase difference $\Delta\varphi$	0°	45°	135°	90°	270°	315°	225°	180°

Differential coding according to VDL is shown in the following table:

Modulation symbol d_n (binary, MSB, LSB)	000	001	010	011	100	101	110	111
Phase difference $\Delta\varphi$	0°	45°	135°	90°	315°	270°	180°	225°

Phase differential coding INMARSAT and PHASE DIFF correspond to system standards Inmarsat-M and DVB according to ETS 300 429. The INMARSAT coding can generally be used for modulation types with 2 bit/symbol, such as QPSK. It uses the following algorithm.



$$dc1_n = [\text{NOT } (d1_n \text{ EXOR } d0_n) \text{ AND } (d1_n \text{ EXOR } dc1_{n-1})] \text{ OR } [(d1_n \text{ EXOR } d0_n) \text{ AND } (d1_n \text{ EXOR } dc0_{n-1})]$$

$$dc0_n = [\text{NOT } (d1_n \text{ EXOR } d0_n) \text{ AND } (d0_n \text{ EXOR } dc0_{n-1})] \text{ OR } [(d1_n \text{ EXOR } d0_{n-1}) \text{ AND } (d0_n \text{ EXOR } dc1_{n-1})]$$

2.10.1.5 Setting Conflicts

As already mentioned in the previous sections, the combination of the above modulation methods with modulation parameters such as symbol rate, filtering and coding is limited. This limitation inevitably causes setting conflicts if a parameter is changed which would lead to an impermissible combination.

Table 2-10 Examples of settings conflicts

	Original status	**Change by selection**	**Conflict**	**Solution**
1	MOD TYPE π/4DQPSK SYMBOL RATE 10 Msymb/s	MOD TYPE→ GMSK	GMSK is only possible for symbol rates up to 7.5 Msymb/s.	Reduction of symbol rate to a value of <7.5 MHz.
2	MOD TYPE 2FSK FILTER GAUSS FILTER PARAMETER 1.0	FILTER → COS	Filter COS 1.0 not possible, the maximum roll-off factor is 0.7.	Setting of FILTER PARAMETER to a value between 0.15 and 0.7.
3	SYMBOL RATE 270 ksymb/s POWER RAMP INT	SYMBOL RATE→5 Msymb/s	Envelope control is only possible for symbol rates up to 2.5 Msymb/s.	Switch-off of envelope control.

If SMIQ cannot resolve a setting conflict, error message SETTINGS CONFLICT is indicated in the status line of the display. In this case, SMIQ uses the user-defined setting in the display. However, the generated modulation signal does not correspond to this indication. The setting conflict can be eliminated by a change of parameters. Error message SETTINGS CONFLICT disappears as soon as a conflict-free setting is reinstated. For a list of possible setting conflicts and error messages for digital modulation see Annex B, thumbnail divider 7.

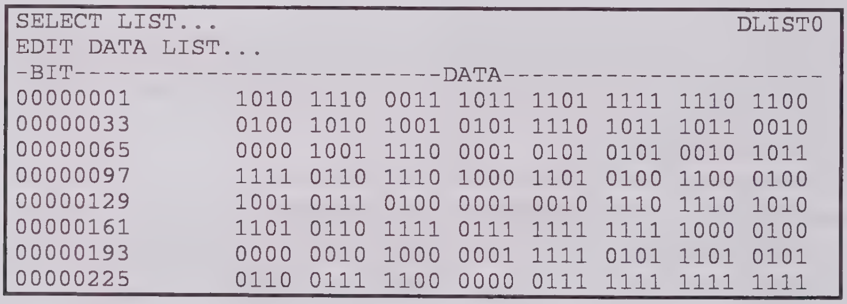
2.10.2 Internal Modulation Data and Control Signals from Lists

If SMIQ is equipped with option Data Generator SMIQB11, modulation data and control signals can be stored in a freely programmable data-generator memory. The storage capacity in the basic configuration is 4 Mbit but can be extended by 8 Mbit or 16 Mbit by fitting one or two SMIQB12 options.
The data are managed via so-called lists. 125 lists can be stored at maximum for modulation data or control signals. A list editor allows to select, copy, change and delete data lists. For a detailed description of the list editor see Section 2.2.11, List Editor.

There are two types of lists, the DATA LIST and the CONTROL LIST.
Lists, as a source for modulation data, can be selected in the menu by entering SOURCE -SOURCE-DATA_LIST and the active list by SOURCE-SELECT DATA LIST.
Lists, as a source for control signals, can be selected in the menu by entering SOURCE -CONTROL STATE ON and the active list by SOURCE-SELECT CONTROL LIST.

Note: *With DATA LIST selected as a source for internal modulation data, the control signals too have to come from a list. In this case, the setting POWER RAMP CONTROL- SOURCE EXTERN DIGITAL issues an error message*
With CONTROL LIST selected as a source for control signals, the modulation data too have to come from a list.

Data Lists:
The DATA LIST has a bit-by-bit layout. The length of the programmed data sequence and the available storage capacity are indicated in the status line of the display.

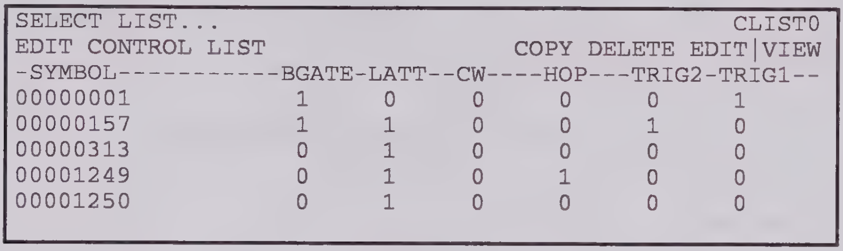


```
SELECT LIST...                                    DLIST0
EDIT DATA LIST...
-BIT-------------------------DATA----------------------
00000001       1010 1110 0011 1011 1101 1111 1110 1100
00000033       0100 1010 1001 0101 1110 1011 1011 0010
00000065       0000 1001 1110 0001 0101 0101 0010 1011
00000097       1111 0110 1110 1000 1101 0100 1100 0100
00000129       1001 0111 0100 0001 0010 1110 1110 1010
00000161       1101 0110 1111 0111 1111 1111 1000 0100
00000193       0000 0010 1000 0001 1111 0101 1101 0101
00000225       0110 0111 1100 0000 0111 1111 1111 1111
```

Fig. 2-44 DATA LIST for modulation data

Control Lists:

A CONTROL LIST can be created to generate control signals that have to be synchronous to the modulation symbols. The CONTROL LIST has a bit-by-bit layout. Six different control signals can be freely programmed. The CONTROL LIST can be created such that entries are only made at those symbol positions where a control signal is changed. The length of the CONTROL LIST is determined by the symbol number of the last entry and can differ from that of the DATA LIST.



```
SELECT LIST...                                              CLIST0
EDIT CONTROL LIST                                 COPY DELETE EDIT|VIEW
-SYMBOL-----------BGATE-LATT--CW----HOP---TRIG2-TRIG1--
00000001             1     0     0     0     0     1
00000157             1     1     0     0     1     0
00000313             0     1     0     0     0     0
00001249             0     1     0     1     0     0
00001250             0     1     0     0     0     0
```

Fig. 2-45 CONTROL LIST for control signals

Signals BGATE (Burst Gate) and LATT (Level Attenuation) are used for envelope control. Envelope control with these signals is switched on by selecting SOURCE-CONTROL STATE ON and POWER RAMP CONTROL - SOURCE INT.

Digital modulation can be switched off by the CW (Continuous Wave) signal. HOP (Hopping) is a trigger signal for frequency hopping (compare with section 'List Mode').

TRIG 1 and TRIG 2 (Trigger Output 1 and 2) can be used to generate synchronization signals such as frame clocks, start markers of a PRBS sequence or a special modulation symbol.

Signals BGATE, LATT, HOP and CW are used internally by SMIQ but not signals TRIG 1 and TRIG 2. All the control signals are available at the PAR DATA interface at the rear of SMIQ.

The data sequences stored in the data generator can be run repetitively (TRIGGER MODE AUTO). Moreover, trigger signals can be used for synchronized sequences. Trigger signals can be fed in via the TRIGIN input at connector PAR DATA. A trigger event can be initiated manually by EXECUTE TRIGGER. A trigger signal is generated upon the trigger event at the output TRIGOUT 3.

After a trigger event, the data generator starts to output modulation data from the active list starting with bit 1. In case of external triggering, the start can be delayed by a selectable number of symbols (EXT TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a selectable number of symbols (EXT TRIGGER INHIBIT).

2.10.3 Internal PRBS Data and Pattern

The PRBS generators in the modulation coder provide pseudo random binary sequences (PRBS) of different length and period. They are called sequences of maximum length and are generated by means of feedback shift registers.
The following schematic shows the 9-bit generator with feedback from registers 4 and 0 (output).

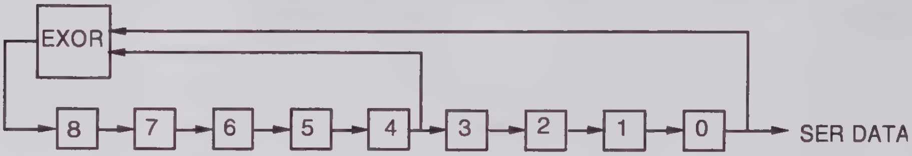


Fig. 2-46 9-bit PRBS generator

The pseudo random sequence of a PRBS generator is determined by the number of registers and the feedback. The following table describes all available PRBS generators:

Table 2-11 PRBS generators of modulation coder

PRBS generator	**Length in bit**	**Feedback to**
9 Bit	$2^9 -1 = 511$	Register 4, 0
15 Bit	$2^{15} -1 = 32767$	Register 1, 0
16 Bit	$2^{16} -1 = 65535$	Register 5, 3, 2, 0
20 Bit	$2^{20} -1 = 1048575$	Register 3, 0
21 Bit	$2^{21} -1 = 2097151$	Register 2, 0
23 Bit	$2^{23} -1 = 8388607$	Register 5, 0

PRBS data as a source for modulation data are selected in the menu via SOURCE - SOURCE PRBS. The period is determined by PRBS LENGTH.

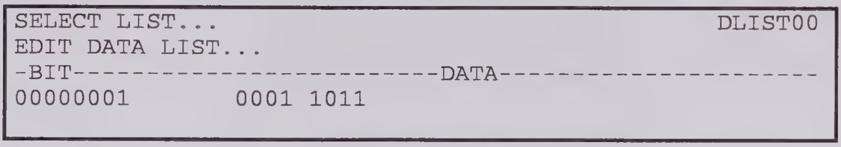
Other internal modulation data are available as simple data patterns such as 0s or 1s. Selection is via SOURCE - SOURCE PATTERN.

Note: *With PRBS data or Pattern selected as source for modulation data, only external control signals can be used. A combination with control signals from lists is not possible.*

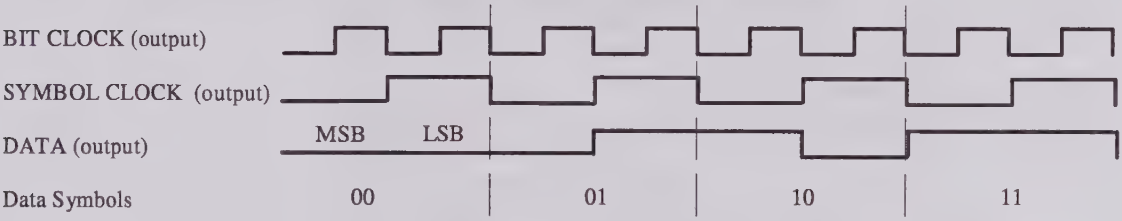
2.10.4 Digital Data and Clock output Signals

2.10.4.1 Serial Interfaces DATA, BIT CLOCK and SYMBOL CLOCK

The following figure shows an example for the output signals at the serial interface for QPSK modulation (2 bits per symbol). A positive CLOCK EDGE is assumed to be set. The following list containing 4 symbols (8 bits) was used as a data source.

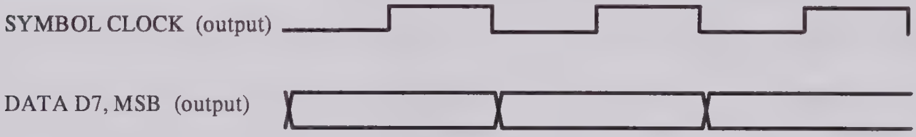


```
SELECT LIST...                                       DLIST00
EDIT DATA LIST...
-BIT--------------------------DATA----------------------
00000001        0001 1011
```



2.10.4.2 Parallel Interfaces DATA and SYMBOL CLOCK

The following figure shows an example for the output signals at the parallel interface. A positive CLOCK EDGE is assumed to be set.



2.10.5 External Modulation Data and Control Signals

Digital modulation signals such as data, clock and signals for envelope control can be externally applied to the modulation coder either via the parallel PAR DATA interface at the rear of SMIQ or via the serial interface with BNC connectors DATA, BIT CLOCK and SYMBOL CLOCK. Moreover, the asynchronous serial interface SERDATA can be used. For a detailed description of the interface hardware see Section Elements at the Rear Panel".

The data source is selected in menu DIGITAL MOD - SOURCE. The clock source is selected in menu DIGITAL MOD - CLOCK irrespective of the data source selection. The polarity of the active clock edge can be changed via DIGITAL MOD - EXT INPUTS - CLOCK SLOPE.

2.10.5.1 External Serial Modulation Data

Serial modulation data can be fed bit-by-bit via connector DATA. For modulation types with more than 1 bit/symbol, the MSB is applied first (MSB first). Either an external bit clock or symbol clock or the internal clock can be used. The symbol clock serves as strobe to mark the LSB of a symbol. If an external bit clock is applied, the data at the active clock edges have to be in a stable state. With external symbol clock, the bit clock for reading the data is internally generated in the modulation coder (internal data clock). The following figures show the timing at the interface. In all the cases shown, the active clock edge is assumed to be positive.

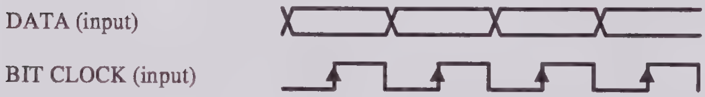


Fig. 2-47 External serial data and bit clock
Data change should take place only on the negative clock edge.

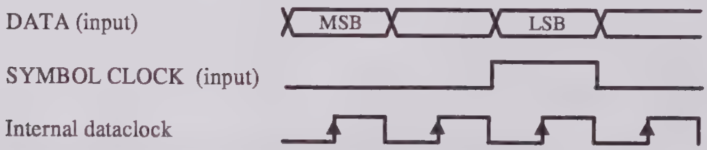


Fig. 2-48 External serial data and symbol clock, 3 bit/symbol
SYMBOL CLOCK = High marks the LSB. A status change of DATA and SYMBOL CLOCK should be performed synchronously.

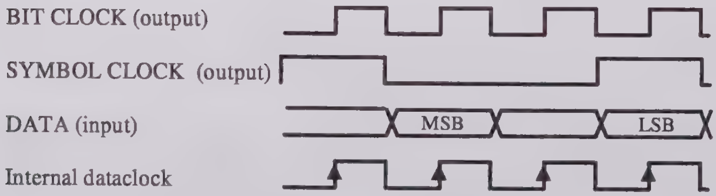


Fig. 2-49 External serial data, internal clock signals

External serial modulation data is selected in the menu by SOURCE-SOURCE-EXT_SER.

2.10.5.2 External Parallel Modulation Data

Parallel data can be fed as symbols via the PAR DATA interface (DATA-D7, -D6 to D0). Either an external symbol clock (SYMBCLK) or the internal symbol clock can be used. The data at the active edge of the symbol clock have to be in a stable state. The following figures show the timings at the interface. In the two examples shown below, the active clock edge is assumed to be positive.

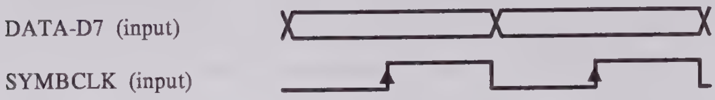


Fig. 2-50 External parallel data and symbol clock
Data change should take place only on the negative clock edge.

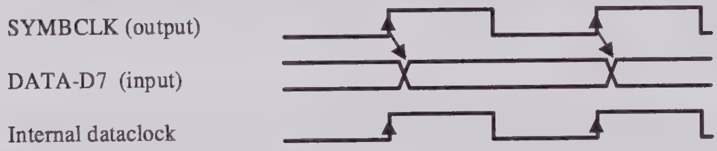


Fig. 2-51 External parallel data and symbol clock
SYMBOL CLOCK = High marks the LSB. A status change of DATA and SYMBOL CLOCK should be performed synchronously.

External serial modulation data is selected in the menu by SOURCE-SOURCE-EXT_SER.

For modulation types with less than 8 bit/symbol, line DATA-D7 is always the MSB. For QPSK modulation, for example (2 bit/symbol), data lines DATA-D7 and DATA-D6 are used.

Note: *BITCLK pin on the PARDATA interface is an output. Synchronization to an external bit clock is not possible in this mode.*

External parallel modulation data is selected in the menu by SOURCE-SOURCE-EXT_PAR.

2.10.5.3 Asynchronous Interface for External Modulation Data

The SERDATA interface on the rear of SMIQ serves for the asynchronous serial transmission of modulation data. The characteristics of this RS-232-C interface is described in Annex A.

For a defined start with specific modulation data it has to be made sure that the backup memories in the RS-232 transmitter and receiver are deleted. The following setting sequence in the menu is required:

1. Carry out desired settings for digital modulation in menu.
2. Select data source SERDATA using SOURCE - SOURCE SERDATA.
3. Make connection to external data source, but do not yet start external data source.
4. Switch off digital modulation using STATE OFF.
5. Set TRIGGER MODE ARMED_AUTO.
   In this state, SMIQ is ready for reception, but discards data that are read in via SERDATA.
6. Switch on digital modulation with STATE ON.
7. Start external data source.
   The read-in data are written into the receiving buffer. Only if this buffer is filled can SMIQ react to a trigger event.
8. Activate trigger event to start digital modulation.

Note: *The baud rate has to be selected at least 25% higher than the bit rate of the digital modulation. If SMIQ has not enough data, the error message "Data underrun" will be issued in the status line.*

2.10.5.4 External Control Signals

The external control signals for envelope control BURST GATE and LEV ATT can be applied via the SERDATA interface at the rear of SMIQ. The signal for CW control can also be applied to this interface.

Note: *The use of control signals from lists in combination with external modulation data is not possible.*

2.10.6 Envelope Control

For TDMA radio networks, in addition to digital modulation, a time-synchronous control of the envelope of the RF output signal is required. To this effect, SMIQ is equipped with an analog envelope modulator which can be driven via connector POWER RAMP. Instead of the analog control signal the digital signals BURST GATE and LEV ATT can be used to control the envelope modulator. In the modulation coder, a ramp with settable slope is obtained from data changes from high→low or low→high of the digital BURST GATE signal. The resulting analog signal is taken to the envelope modulator and is provided at connector POWER RAMP. The LEV ATT signal serves for a defined level reduction.

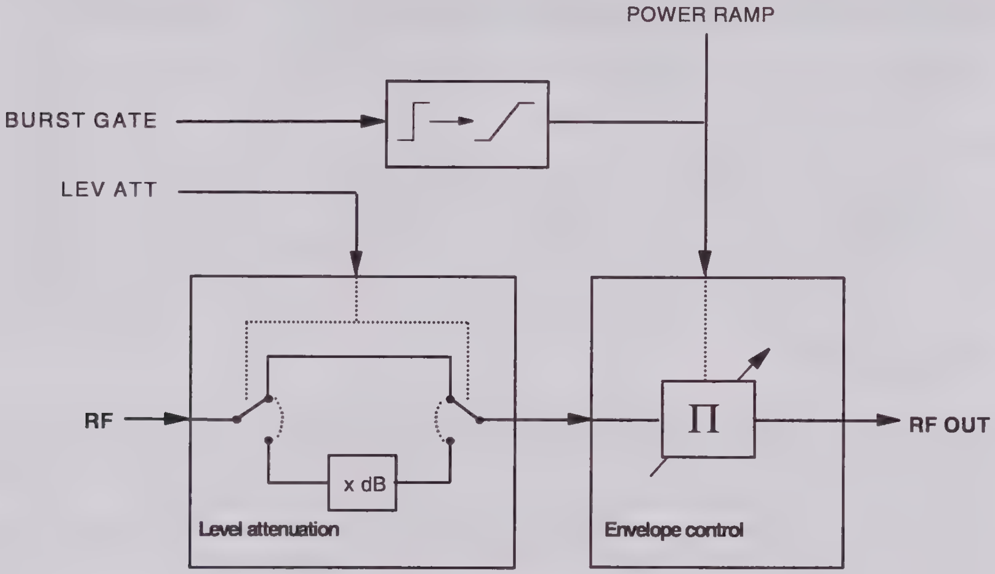


Fig. 2-52 Envelope control in SMIQ with modulation coder

The digital envelope control signals can be fed in externally via connector PAR DATA. With option Data Generator SMIQB11 provided, the signals can also be generated internally by programming them in the CONTROL LIST (see Section "Modulation Data from Lists").

The following table shows the logic function of the two signals BURST GATE and LEV ATT.

Table 2-12 Logic function of signals BURST GATE and LEVEL ATT

BURST GATE	LEV ATT	Remark
1	0	Full level
1	1	Level reduced by the value set in dB under POWER RAMP CONTROL - ATTENUATION
0	X	Maximum level reduction

The following figure illustrates the effect of the envelope control signals.

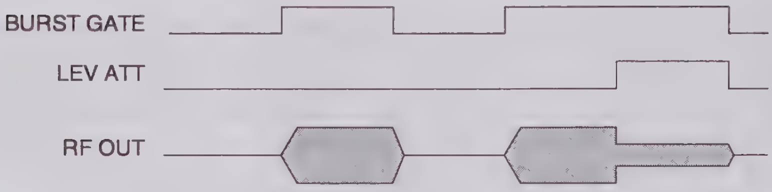


Fig. 2-53 Signal waveforms during envelope control

Note: Envelope control with digital input signals and edge shaping is only possible for symbol rates of maximum 2.5 Msymb/s.

Envelope control is switched on in the menu via:

analog	POWER RAMP CONTROL - SOURCE - EXT ANALOG.
external digital	POWER RAMP CONTROL - SOURCE - EXT DIGITAL.
internal digital	POWER RAMP CONTROL - SOURCE - INT and SOURCE CONTROL STATE ON.

2.10.7 Clock Signals

The symbol clock and the bit clock are generated in SMIQ by a clock synthesizer on the modulation coder. All clock signals are synchronized to the 10 MHz reference of the unit. The symbol clock is available at the SYMBOL CLOCK connector and the bit clock at the BIT CLOCK connector. If required, the clock synthesizer in SMIQ can synchronize to an externally applied symbol or bit clock.
Only during an operation with external parallel data is synchronization to one symbol clock possible. This symbol clock is applied via the PAR DATA interface. In all other cases, apply symbol and bit clock to the corresponding BNC connector.

The clock signal is selected in the menu via CLOCK-MODE SYMBOL/BIT and CLOCK-CLOCK SOURCE EXT.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Notes: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

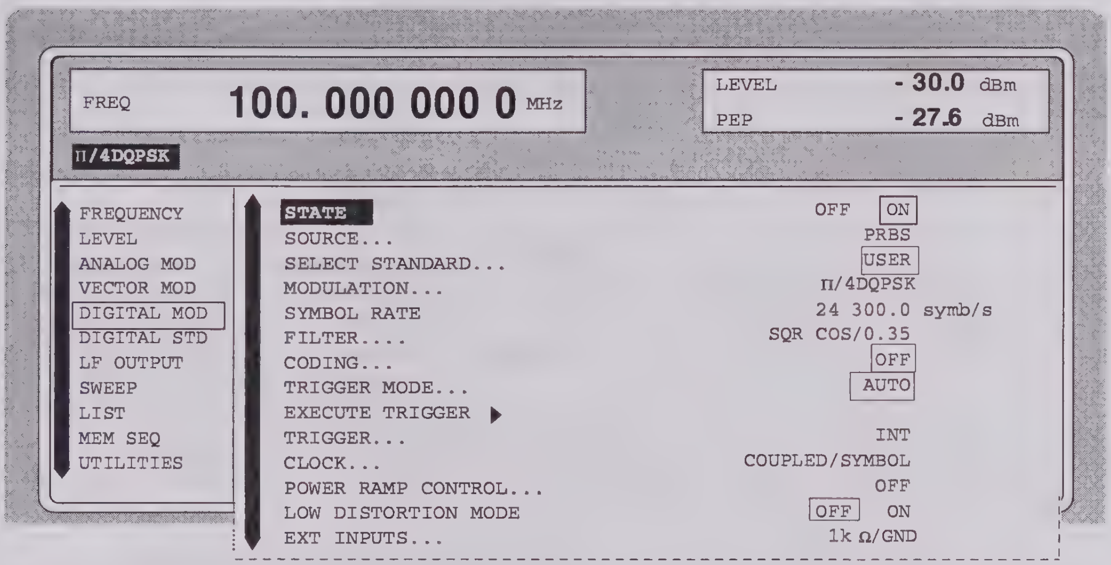
2.10.8 RF Level For Digital Modulation

With modulation switched on, a level display divided in half appears in the header of the display. The peak envelope power (PEP) of the modulated RF output level is displayed in addition to average power (LEVEL).
The difference between PEP and LEVEL depends on the modulation type and the filtering. The power of QAM signals is calculated on the assumption of a uniform distribution of modulation symbols. For the PEP calculation, it is always assumed that the most unfavourable case occurs in the sequence of modulation data. This is definitely the case for PRBS data with a long period (eg PRBS LENGTH 23 bit). For other data sequences it is possible that the indicated PEP is not attained.

2.10.9 Digital Modulation Menu

The DIGITAL MOD menu provides access to digital modulation settings.

Menu selection: DIGITAL MOD



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

Π/4DQPSK

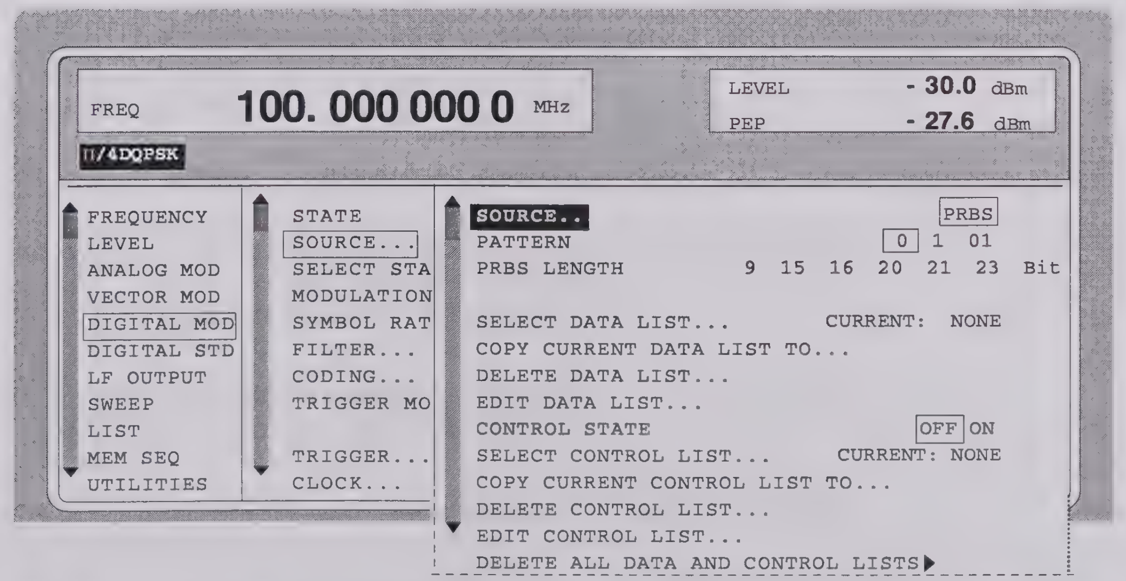
STATE OFF ON
SOURCE... PRBS
SELECT STANDARD... USER
MODULATION... Π/4DQPSK
SYMBOL RATE 24 300.0 symb/s
FILTER.... SQR COS/0.35
CODING... OFF
TRIGGER MODE... AUTO
EXECUTE TRIGGER ▶
TRIGGER... INT
CLOCK... COUPLED/SYMBOL
POWER RAMP CONTROL... OFF
LOW DISTORTION MODE OFF ON
EXT INPUTS... 1k Ω/GND

Fig. 2-54 DIGITAL MOD menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

STATE Switch on/off of digital modulation.

IEC/IEEE-bus command `SOUR:DM:STAT ON`

SOURCE... Opens a window for defining the data source for digital modulation. Menu selection depends on option SMIQB11. If option SMIQB11 is installed, the menu provides more selections and settings for modulation data from lists.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

Π/4DQPSK

SOURCE.. PRBS
PATTERN 0 1 01
PRBS LENGTH 9 15 16 20 21 23 Bit
SELECT DATA LIST... CURRENT: NONE
COPY CURRENT DATA LIST TO...
DELETE DATA LIST...
EDIT DATA LIST...
CONTROL STATE OFF ON
SELECT CONTROL LIST... CURRENT: NONE
COPY CURRENT CONTROL LIST TO...
DELETE CONTROL LIST...
EDIT CONTROL LIST...
DELETE ALL DATA AND CONTROL LISTS ▶

Fig. 2-55 DIGITAL MOD-SOURCE menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(SOURCE...)

SOURCE...

Opens a window for selecting the source for modulation data.

EXT_PAR	The modulation data are fed in via the parallel PAR DATA interface at the rear of SMIQ. IEC -bus	`:SOUR:DM:SOUR PAR`
EXT_SER	The modulation data are fed in serially at input DATA. IEC -bus	`:SOUR:DM:SOUR SER`
PATTERN	A simple data pattern is continuously generated. IEC-bus	`:SOUR:DM:SOUR PATT`
PRBS	A pseudo random bit sequence is generated and continuously repeated. IEC -bus	`:SOUR:DM:SOUR PRBS`
SERDATA	The modulation data are fed in via the asynchronous SER_DATA interface. IEC -bus	`:SOUR:DM:SOUR SDAT`
DATA LIST	Modulation data from lists IEC-bus	`:SOUR:DM:SOUR DLIS`

PATTERN

Selection of a simple data pattern which is continuously generated.

0	0s are continuously generated. IEC -bus	`:SOUR:DM:PATT ZERO`
1	1s are continuously generated. IEC -bus	`:SOUR:DM:PATT ONE`
01	010 data changes are continuously generated. IEC -bus	`:SOUR:DM:PATT ALT`

PRBS LENGTH

Setting of PRBS generator length. 9 bit, 15 bit, 16 bit, 20 bit, 21 bit and 23 bit can be selected. The period of the data sequence is then between 2^9-1 and 2^{23}-1 bit (see Section 2.10.3 "Internal PRBS Data and Pattern").

IEC/IEEE-bus command `:SOUR:DM:PRBS 15`

SELECT DATA LIST

Opens a window for selecting a stored data list or for generating a new list.

IEC/IEEE-bus `:SOUR:DM:DLIS:SEL ´name´`

COPY CURRENT DATA LIST TO

Stores the current data list under a different name.

IEC/IEEE-bus `:SOUR:DM:DLIS:COPY ´name´`

DELETE DATA LIST

Deletes a data list.

(SOURCE...)

EDIT DATA LIST

Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

CONTROL STATE

ON	The signals from the selected CONTROL LIST are effective.
OFF	The signals are not effective
IEC/IEEE-bus	`:SOUR:DM:CLIS:CONT ON`

SELECT CONTROL LIST

Opens a window for selecting a stored list for control signals or for generating a new list for control signals.

IEC/IEEE-bus `:SOUR:DM:CLIS:SEL ´name´`

COPY CURRENT CONTROL LIST TO

Stores the current list for control signals under a different name.

IEC/IEEE-bus `:SOUR:DM:CLIS:COPY ´name´`

DELETE CONTROL LIST

Deletes a list for control signals.

EDIT CONTROL LIST

Opens a window for editing a list for control signals symbol-by-symbol. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

DELETE ALL DATA AND CONTROL LISTS ▶

Deletes all data lists and lists for control signals.

IEC/IEEE-bus -

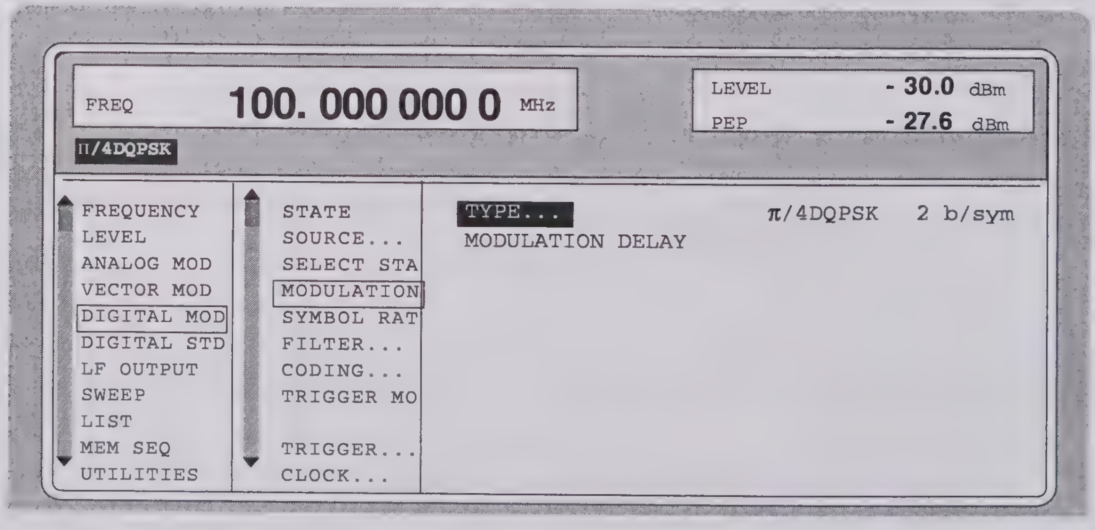
SELECT STANDARD...

Opens a window for selecting the standard. After the selection, the modulation parameters MODULATION, SYMBOL RATE, FILTER and CODING are automatically adjusted to the standard. USER is indicated if the settings of these parameters do not correspond to the selected standard. The following standards are available:

APCO4FM	IEC\IEEE-bus command	:SOUR:DM:STAN APCF
APCOQPSK	IEC\IEEE-bus command	:SOUR:DM:STAN APCQ
CDPD	IEC/IEEE-bus command	:SOUR:DM:STAN CDPD
CT2	IEC/IEEE-bus command	:SOUR:DM:STAN CT2
DECT	IEC/IEEE-bus command	:SOUR:DM:STAN DECT
GSM	IEC/IEEE-bus command	:SOUR:DM:STAN GSM
GSM_EDGE	IEC/IEEE-bus command	:SOUR:DM:STAN GSME
IRIDIUM	IEC\IEEE-bus command	:SOUR:DM:STAN IRID
IS95 FWD	IEC\IEEE-bus command	:SOUR:DM:STAN FIS95
IS95 REV	IEC\IEEE-bus command	:SOUR:DM:STAN RIS95
NADC	IEC/IEEE-bus command	:SOUR:DM:STAN NADC
PDC	IEC/IEEE-bus command	:SOUR:DM:STAN PDC
PHS	IEC/IEEE-bus command	:SOUR:DM:STAN PHS
TETRA	IEC/IEEE-bus command	:SOUR:DM:STAN TETR
TFTS	IEC/IEEE-bus command	:SOUR:DM:STAN TFTS
PWT	IEC/IEEE-bus command	:SOUR:DM:STAN PWT
ICOBPSK	IEC\IEEE-bus command	:SOUR:DM:STAN ICQB
ICOGMSK	IEC\IEEE-bus command	:SOUR:DM:STAN ICQG
ICOQPSK	IEC\IEEE-bus command	:SOUR:DM:STAN ICQQ
WORLDSPACE	IEC\IEEE-bus command (only with option SMIQB17)	:SOUR:DM:STAN WORL
WCDMA QPSK	IEC/IEEE-bus command (only with option SMIQB47)	:SOUR:DM:STAN QWCD
ARIB STD-T55	IEC/IEEE-bus command	:SOUR:DM:STAN AT55

MODULATION...

Opens a window for defining the modulation method. Moreover, the number of bits per modulation symbol is displayed. See also Section "Digital Modulation Methods and Coding".



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

TYPE... π/4DQPSK 2 b/sym

Fig. 2-56 DIGITAL MOD - MODULATION... menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(MODULATION...) **TYPE...**

Opens a window for selecting the modulation method. The following modulations can be selected. If user-defined mapping lists are available, they can hence be selected. The mapping lists are transmitted via IEC/IEEE-bus (command `:DM:MLISt`).

ASK	Amplitude Shift Keying IEC/IEEE-bus `:DM:FORM ASK`
BPSK	Binary Phase Shift Keying IEC/IEEE-bus `:DM:FORM BPSK`
QPSK	Quadrature Phase Shift Keying IEC/IEEE-bus `:DM:FORM QPSK`
QPSK IS95	Quadrature Phase Shift Keying with a mapping according to Interim Standard 95 for CDMA IEC/IEEE-bus `:DM:FORM QIS95`
QPSK ISAT	QPSK Modulation for INMARSAT-M IEC/IEEE-bus `:DM:FORM QINM`
QPSK ICO	QPSK Modulation for ICO IEC/IEEE-bus `:DM:FORM QICO`
WCDMA QPSK	QPSK Modulation for W-CDMA IEC/IEEE-bus `:DM:FORM QWCD` WCDMA QPSK only with option SMIQB47
OQPSK	Offset Quadrature Phase Shift Keying IEC/IEEE-bus `:DM:FORM OPSK`
OQPSK IS95	Quadrature Phase Shift Keying with a mapping according to Interim Standard 95 for CDMA IEC/IEEE-bus `:DM:FORM OIS95`
π/4 QPSK	QPSK with π/4 rotation for each symbol step (use: NSTAR) IEC/IEEE-bus `:DM:FORM P4QP`
π/4 DQPSK	QPSK with differential coding IEC/IEEE-bus `:DM:FORM P4DQ`
8PSK	Phase Shift Keying with 8 points in the constellation diagram IEC/IEEE-bus `:DM:FORM PSK8`
8PSK EDGE	Phase Shift Keying with 8 points in the constellation diagram and 3 π/8 rotation per symbol. IEC/IEEE-bus `:DM:FORM PSKE8`
GMSK	Gaussian Minimum Shift Keying IEC/IEEE-bus `:DM:FORM GMSK`
GFSK	Gaussian filtered Frequency Shift Keying IEC/IEEE-bus `:DM:FORM GFSK`
2FSK, 4FSK	Frequency Shift Keying IEC/IEEE-bus `:DM:FORM FSK2`
4FSK APCO	Frequency Shift Keying acording to APCO25 IEC/IEEE-bus `:DM:FORM AFSK4`
QAM	Quadrature Amplitude Modulation with 16, 32, 64 or 256 points in the constellation diagram IEC/IEEE-bus `:DM:FORM QAM16`

(MODULATION)

FSK DEVIATION

Input value of deviation with FSK or GFSK selected.

IEC/IEEE-bus `:SOUR:DM:FSK:DEV 100 KHZ`

MODULATION DELAY

Value for time delay of digital modulation between data input/output and RF output of .

IEC/IEEE-bus `:SOUR:DM:MDEL?`

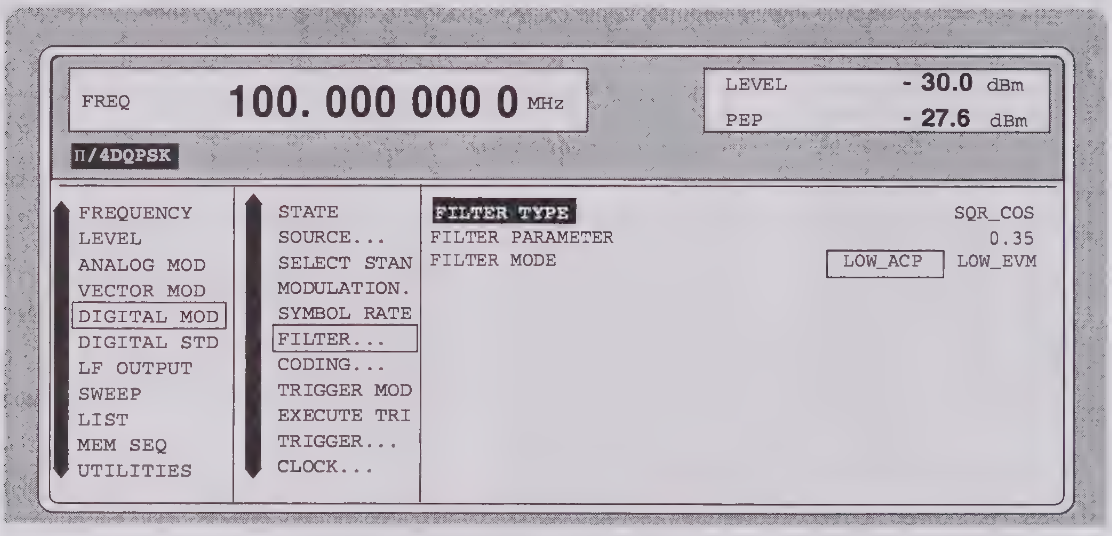
SYMBOL RATE

Input value of symbol rate.

IEC/IEEE-bus command `:SOUR:DM:SRAT 1.2288 MHZ`

FILTER...

Opens a window for setting the baseband filtering.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

FILTER TYPE SQR_COS

FILTER PARAMETER 0.35

FILTER MODE LOW_ACP LOW_EVM

Fig. 2-57 DIGITAL MOD -FILTER... menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(FILTER...)

FILTER TYPE

Opens a window for selecting a type of filter. The following filters can be selected:

SQR_COS	Square Root RaisedCosine IEC `:SOUR:DM:FILT:TYPE SCOS`
COS	Cosine IEC `:SOUR:DM:FILT:TYPE COS`
GAUSS	Gaussian filter IEC `:SOUR:DM:FILT:TYPE GAUS`
GAUSS LINEAR	Linearized Gaussian filter for GSM_EDGE. IEC `:SOUR:DM:FILT:TYPE LGA`
BESSEL	Bessel filter with B×T = 1.25 or 2.5 IEC `:SOUR:DM:FILT:TYPE BESS1`
IS95	Filter for CDMA mobile station according to Interim Standard 95 IEC `:SOUR:DM:FILT:TYPE IS95`
IS95 EQUAL	Filter for CDMA base station with equalizer according to IS-95 IEC `:SOUR:DM:FILT:TYPE EIS95`
APCO C4FM	Cosine filter with si(x)-compensation according to APCO25 standard for 4FSK modulation. IEC `:SOUR:DM:FILT:TYPE APCO`
TETRA	Filter for PSK/QAM modulation. IEC `:SOUR:DM:FILT:TYPE TETR`
WCDMA0.22	Filter for PSK modulation. Square Root Raised Cosine filter with Roll Off = 0.22, optimized for W-CDMA IEC `:SOUR:DM:FILT:TYPE WCDM`
RECTANGLE	Filter with a rectangular impulse answer of 1 symbol length. IEC `:SOUR:DM:FILT:TYPE RECT`
SPLIT PHASE	Filter for ASK modulation IEC `:SOUR:DM:FILT:TYPE SPH`

FILTER PARAMETER

Opens a window for setting the filter parameter. The selection depends on the selected filter type:

Parameter	**Filter Type**
Roll-off factor	SQR COS, COS, or APCO:
Normalized band width $B \times T_{Symb}$	GAUSS .

IEC/IEEE-bus `:SOUR:DM:FILT:PAR 0.2`

FILTER MODE

Selection of filter mode.

LOW_ACP	Filter for minimum <u>A</u>djacent <u>C</u>hannel <u>P</u>ower IEEE `:SOUR:DM:FILT:MODE LACP`
LOW_EVM	Filter for minimum vector error IEEE `:SOUR:DM:FILT:MODE LEVM`

CODING... Opens a window for setting the modulation coding. See also Section " Digital Modulation Methods and Coding. The following codings can be selected:

OFF	No coding	
	IEC-bus command	`:SOUR:DM:COD OFF`
DIFF	Differential coding	
	IEC-bus command	`:SOUR:DM:COD DIFF`
PHASE_DIFF	Phase differential coding	
	IEC-bus command	`:SOUR:DM:COD DPHS`
GRAY+DIFF	Gray and differential coding	
	IEC-bus command	`:SOUR:DM:COD DGR`
GSM	Differential coding according to GSM standard	
	IEC-bus command	`:SOUR:DM:COD GSM`
NADC	Differential coding for $\pi/4$ DQPSK according to NADC standard	
	IEC-bus command	`:SOUR:DM:COD NADC`
PDC	Differential coding according to PDC standard	
	IEC-bus command	`:SOUR:DM:COD PDC`
PHS	Differential coding according to PHS standard	
	IEC-bus command	`:SOUR:DM:COD PHS`
TETRA	Differential coding for $\pi/4$ DQPSK according to TETRA standard	
	IEC-bus command	`:SOUR:DM:COD TETR`
APCO25	Differential coding according to APCO25 standard	
	IEC-bus command	`:SOUR:DM:COD APCO25`
PWT	Differential coding for $\pi/4$ DQPSK according to PWT standard	
	IEC-bus command	`:SOUR:DM:COD PWT`
TFTS	Differential coding for $\pi/4$ DQPSK according to TFTS standard	
	IEC-bus command	`:SOUR:DM:COD TFTS`
INMARSAT	Phase differential coding for INMARSAT-M QPSK modulation	
	IEC-bus command	`:SOUR:DM:COD INM`
VDL	Differential coding according to VDL (VHF Digital Link) for 8PSK modulation.	
	IEC-bus command	`:SOUR:DM:COD VDL`

TRIGGER MODE

Selection of trigger mode.

This selection is only available when option SMIQB11 is installed.

AUTO — The data sequences from the selected DATA LIST and CONTROL LIST are continuously repeated.

IEC/IEEE-bus command `:SOUR:DM:SEQ AUTO`

RETRIG — The data sequences are continuously repeated. A trigger event causes a restart from symbol 1.

IEC/IEEE-bus command `:SOUR:DM:SEQ RETR`

ARMED_AUTO — A start of data sequences from symbol 1 is caused by a trigger event. The unit is then automatically set to AUTO and can no longer be triggered.

IEC/IEEE-bus command `:SOUR:DM:SEQ AAUT`

ARMED_RETRIG — A start of data sequences from symbol 1 is only caused by a trigger event. The unit is then automatically set to RETRIG. Each new trigger event causes a restart of the data sequences.

IEC/IEEE-bus command `:SOUR:DM:SEQ ARET`

SINGLE — A trigger event causes a single data sequence run.

IEC/IEEE-bus command `:SOUR:DM:SEQ SING`

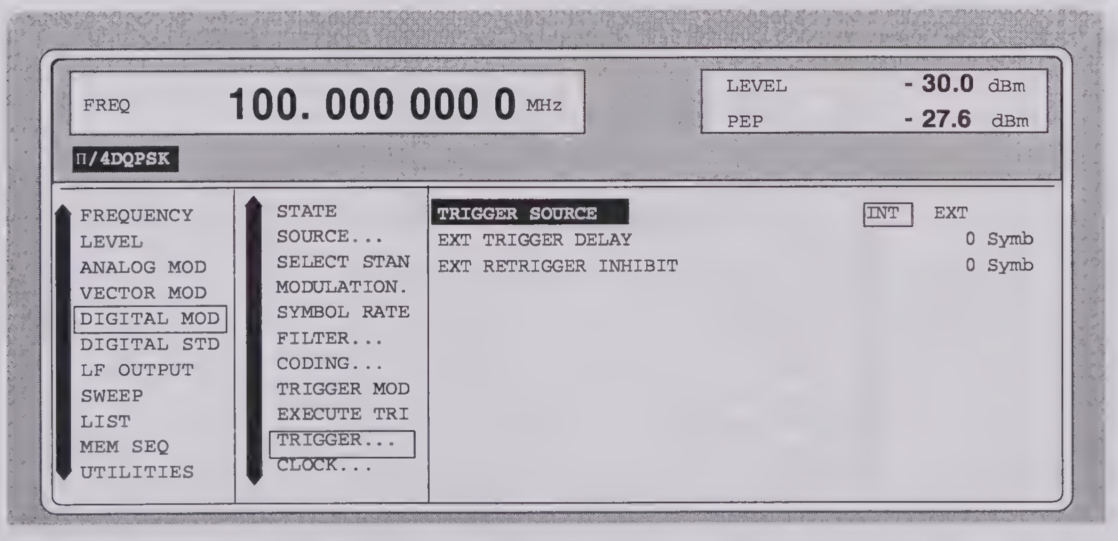
EXECUTE TRIGGER ▶

Executes a trigger event to start a data sequence.

IEC/IEEE-bus command `:TRIG:DM:IMM`

TRIGGER...

Opens a window for setting the different types of trigger and for setting the time delay of the trigger signal. The menu is only available if SMIQ is equipped with option Data Generator SMIQB11.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

Π/4DQPSK

TRIGGER SOURCE [INT] EXT

EXT TRIGGER DELAY 0 Symb

EXT RETRIGGER INHIBIT 0 Symb

Fig. 2-58 DIGITAL MOD - TRIGGER menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(TRIGGER...)

TRIGGER SOURCE

Selection of trigger source

EXT	An external trigger signal can be fed in at TRIGIN of connector PAR DATA at the rear of SMIQ. With the active edge, a data sequence is started from the data generator memory.
INT	With INT selected, a trigger event can be manually executed by EXECUTE TRIGGER.

IEC/IEEE-bus `:SOUR:DM:TRIG:SOUR EXT`

EXT TRIGGER DELAY

Input value of number of symbols by which an external trigger signal is delayed before it starts the data sequence in the data generator. A synchroneity with the DUT or other units can thus be achieved.

IEC/IEEE-bus `:SOUR:DM:TRIG:DEL 3`

EXT RETRIGGER INHIBIT

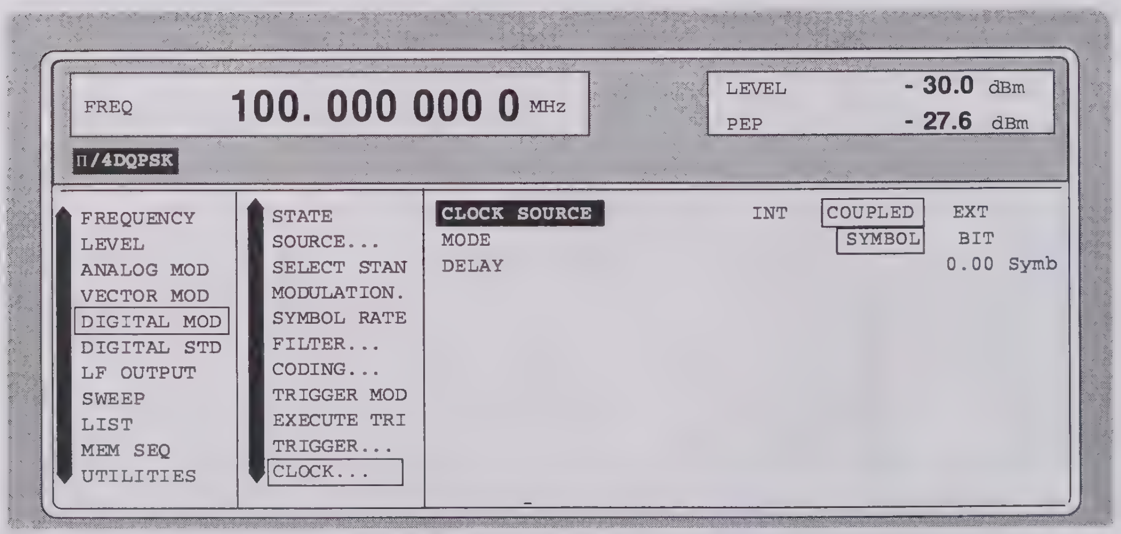
Input of number of symbols for which each new trigger event is inhibited during MODE RETRIG after a trigger signal.

During MODE RETRIG, each new trigger signal restarts the data sequence in the data generator. This restart can be inhibited for the entered number of symbols. The entry of 1250 symbols, for example, causes new trigger signals to be ignored for the duration of 1250 symbols after execution of a trigger event.

IEC/IEEE-bus `:SOUR:DM:TRIG:INH 1250`

CLOCK...

Opens a window for selecting the clock source and for setting a delay.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

π/4DQPSK

CLOCK SOURCE INT COUPLED EXT

MODE SYMBOL BIT

DELAY 0.00 Symb

Fig. 2-59 DIGITAL MOD - CLOCK, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(CLOCK...)

CLOCK SOURCE

Selection of clock source

INT	The symbol and the bit clock in SMIQ are generated by a clock synthesizer on the modulation coder. All the clock signals are synchronized to the 10-MHz reference of the unit. IEEE-bus `:SOUR:DM:CLOC:SOUR INT`
COUPLED	The clock comes from the same source as the data. IEEE-bus `:SOUR:DM:CLOC:SOUR COUP`
EXT	An external clock signal is fed externally. The clock synthesizer on the modulation coder is synchronized to this clock. Parameter SYMBOL RATE has to be correctly set with an accuracy of ± 1 %. IEEE-bus `:SOUR:DM:CLOC:SOUR EXT`

MODE

Selection of clock for the external clock signal

SYMBOL	An externally fed clock has to be a symbol clock.
BIT	An externally fed clock has to be a bit clock.

IEC/IEEE-bus `:SOUR:DM:CLOC:MODE SYMB`

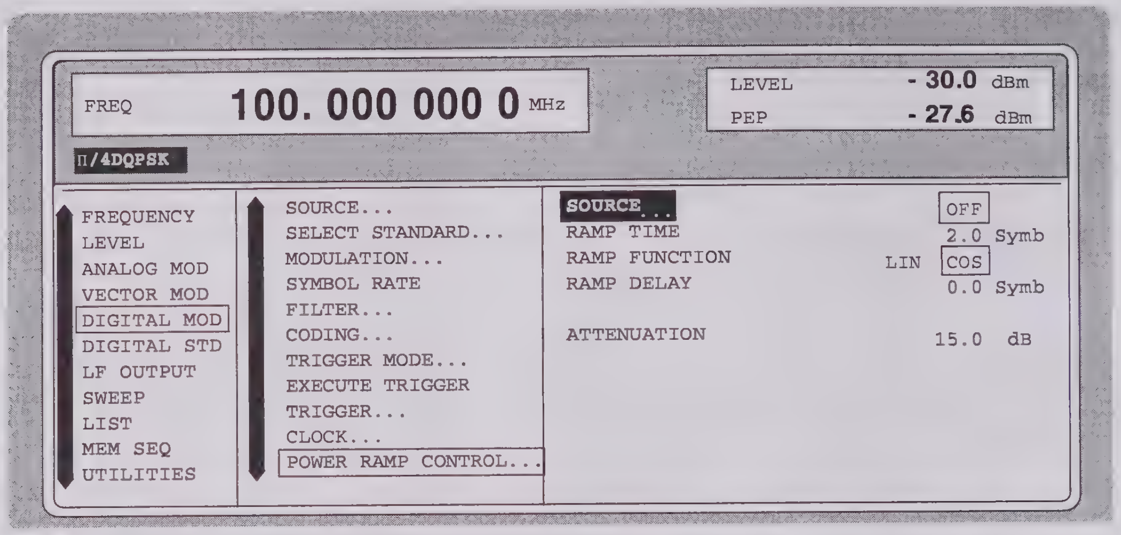
DELAY

Input value of delay of generated modulation signal compared with an externally fed clock. This can be used, for example, for synchronization with a second unit to achieve time synchroneity between the modulation signals of the two units. The displayed setting resolution of 1/100 symbol is only attained for symbol-clock frequencies below 100 kHz. The actual resolution is reduced with increasing frequency. The delay can no longer be set for 7 Msymb/s

IEC/IEEE-bus `:SOUR:DM:CLOC:DEL 0.5`

POWER RAMP CONTROL...

Opens a window for setting the envelope control.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

SOURCE... OFF

RAMP TIME 2.0 Symb

RAMP FUNCTION LIN COS

RAMP DELAY 0.0 Symb

ATTENUATION 15.0 dB

Fig. 2-60 DIGITAL MOD - POWER RAMP CONTROL menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(POWER RAMP CONTROL...)

SOURCE

Selection between analog and digital envelope control and selection of source.

OFF Envelope control is switched off.

IEC/IEEE `:SOUR:DM:PRAM:STAT OFF`

INT Signals BGAT and LATT from the active CONTROL LIST (CLIST) are used for envelope control (only with option SMIQB11)

IEC/IEEE `:SOUR:DM:PRAM:STAT ON`
`:SOUR:DM:PRAM:SOUR CLIST`

EXT_ANALOG Envelope control is via an external analog signal that can be fed in via connector POWER RAMP.

IEC/IEEE-bus commands
`:SOUR:DM:PRAM:STAT ON`
`:SOUR:DM:PRAM:SOUR AEXT`

EXT_DIGITAL Envelope control is via external digital signals to be applied to BURST GATE and LEV ATT of connector PAR DATA.

IEC/IEEE-bus commands
`:SOUR:DM:PRAM:STAT ON`
`:SOUR:DM:PRAM:SOUR DEXT`

RAMP TIME

Input value of rise time of envelope after a transition from Low→High of signal BURST GATE and of fall time after a transition from High→Low.
The setting is a multiple of the symbol duration.

IEC/IEEE-bus `:SOUR:DM:PRAM:TIME 3.0`

(POWER RAMP CONTROL...)

RAMP FUNCTION

Determines the shape of the rising and falling edge during envelope control by means of the BURST GATE signal.

LIN	Selection of a linear ramp function.
COS	The edge is shaped according to a cosine function and a more favourable spectrum than that under setting LIN is obtained.

IEC/IEEE-bus `:SOUR:DM:PRAM:SHAP COS`

RAMP DELAY

Input value for a shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope. The values are set in the units of the symbol length.

IEC/IEEE-bus `:SOUR:DM:PRAM:DEL 0.1`

ATTENUATION

Input value of level reduction in dB with digital control signal LEV ATT used. This function is normally used - for TDMA frame structures - to generate a slot with reduced level.

IEC/IEEE-bus `:SOUR:DM:PRAM:ATT 0 dB`

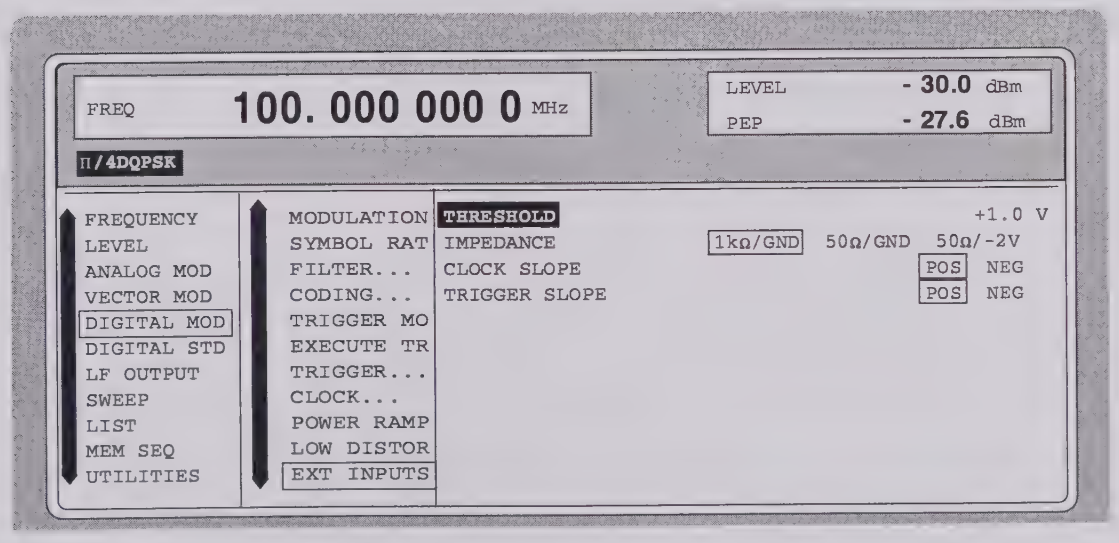
LOW DISTORTION MODE

After switch-on (ON), the level of the IQ baseband signals is reduced by 3 dB. In some cases, this might reduce undesired intermodulation products. OFF is normally the more favourable setting.

IEC/IEEE-bus `:SOUR:DM:LDIS ON`

EXT INPUTS

Opens a window for setting the trigger threshold, input impedance and polarity of the external digital modulation coder inputs, ie connector PAR DATA and inputs DATA, BIT CLOCK and SYMBOL CLOCK.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

Π/4DQPSK

THRESHOLD +1.0 V

IMPEDANCE [1kΩ/GND] 50Ω/GND 50Ω/-2V

CLOCK SLOPE [POS] NEG

TRIGGER SLOPE [POS] NEG

Fig. 2-61 DIGITAL MOD - EXT INPUTS menu, SMIQ equipped with option Modulation Coder SMIQB20 and option Data Generator SMIQB11

(EXT INPUTS...)	**TRESHOLD**	Input value of high/low threshold in Volt. IEC/IEEE-bus command `:SOUR:DM:THR 1.0`
	IMPEDANCE	Selection of input impedance and reference voltage. 50 Ω/GND should be selected for higher clock rates. Setting 50 Ω/-2V is suitable for sources with ECL output. Make sure to select a suitable setting for the high/low threshold under TRESHOLD. IEC/IEEE-bus command `:SOUR:DM:INP:IMP G1K`
	CLOCK SLOPE	Selection of polarity of active edge of externally fed bit clock or symbol clock. ***Note:*** *In the internal clock mode, CLOCK SLOPE NEG inverts the clock output signals.* IEC/IEEE-bus `:SOUR:DM:CLOC:POL NORM`
	TRIGGER SLOPE	Selection of polarity of active trigger edge for input TRIGIN. IEC/IEEE-bus `:SOUR:DM:TRIG:SLOP POS`

2.11 Digital Standard PHS

With the options Modulation Coder (SMIQB20) and Data Generator (SMIQB11) provided, modulation signals according to the Japanese PHS standard[1] can be generated. PHS is a TDMA standard for private and public cordless phones.

SMIQ can generate both the transmit signal of a cell station (CS) and the transmit signal of a personal station (PS). Transmission from CS to PS is called "downlink", "uplink" being used for transmission in the opposite direction.

Uplink and downlink are transmitted in the separate time slots of a frame using the time duplex method. Each frame consists of 8 slots. The data contents of each slot can be defined individually by SMIQ by means of a slot editor. SMIQ can generate a control physical slot and also a communication physical slot. Each slot can be switched on or off. A defined intermediate level can also be set.

A burst type has to be defined to configure a slot. The following burst types can be selected:

- TCHFULL simulation of a communication channel for a speech coder rate of 32 kbit/s,
- TCHHALF simulation of a communication channel for a speech coder rate of 16 kbit/s,
- VOX simulation of a communication channel in non-speech intervals with uplink transmission only in every fourth frame,
- SYNC, simulation of a sync channel and
- ALL_DATA burst type for test purposes with freely programmable data contents in the selected slot.

The following internal modulation sources are available:

- different PRBS generators with a sequence length between 2^9-1 and 2^{23}-1 and
- data lists, ie freely programmable data sequences from the data generator memory.

For generating the PHS signals, SMIQ inserts the modulation data continuously (in real time) into the selected slots. Using a digital signal processor the data generator generates a data sequence with modulation data and control signals for envelope control.

The data generator in SMIQ generates a data stream which is converted into IQ signals in the modulation coder. According to the PHS standard, the modulation type is $\pi/4$ DQPSK at a symbol rate of 192 ksymbol/s and √COS filtering. Symbol rate and filtering can be changed in SMIQ.

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[1] Personal Handy Phone System ARIB Standard (RCR STD-28)

2.11.1 Sync and Trigger Signals

The data generator generates a data sequence with modulation data, control signals for envelope control, and synchronization signals.

When TRIGGER MODE AUTO is selected, the PHS signal generation automatically starts.

This start can also be activated by an external trigger signal (TRIGGER MODE ARMED_AUTO) which allows a synchronous sequence for BER measurements to be carried out on receivers.

Trigger signals for synchronized sequences can be used for measuring the bit error rate of receivers. A trigger signal can be fed via the TRIGIN input at connector PAR DATA. The active slope of a trigger signal applied there executes a trigger event.
PHS signal generation at a frame limit is started after a trigger event. Data from data lists are inserted into the selected slots starting from the first bit. PRBS generators start with the set initialization status.

Signal generation either starts immediately after the active slope of the trigger signal or after a settable number of symbols (EXT TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a settable number of symbols (EXT RETRIGGER INHIBIT).

A trigger event can be executed manually or via the IEC/IEEE bus using EXECUTE TRIGGER.

When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ also generates the following sync signals:

- a frame clock at TRIGOUT 1 output,
- a frame or multiframe clock at TRIGOUT 2 output with settable position in the frame,
- the symbol clock and the bit clock.

A clock synthesizer on the modulation coder generates the symbol clock and the bit clock in SMIQ. All the clock signals are synchronized to the 10-MHz reference of SMIQ. The symbol clock is available at connector SYMBOL CLOCK and the bit clock at connector BIT CLOCK. If required, the clock synthesizer in SMIQ can be synchronized to an external symbol or bit clock.

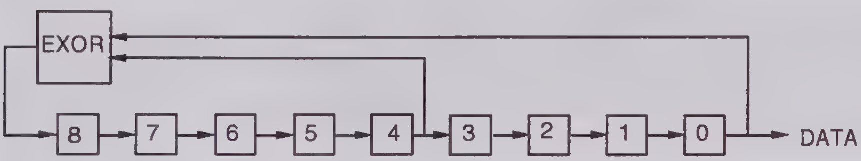
The clock signal is selected in the menu via CLOCK-CLOCK SOURCE EXT.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Notes: - *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.11.2 PN Generators as Internal Data Source

Independent PN generators (Pseudo Noise) can be selected for each slot as data source for data fields DATA and SACCH. These PN generators provide pseudo-random bit sequences of different length or period. That is why they are also called PRBS generators (Pseudo Random Binary Sequence).
Data sequences are sequences of maximum length which are generated by means of feedback shift registers.
The following figure gives an example of a 9 bit generator with feedbacks after register 4 and 0 (output).



The pseudo-random sequence of a PRBS generator is clearly defined by the number of registers and the feedback. The following table describes all PRBS generators available:

Table 2-13 PRBS generators for PHS

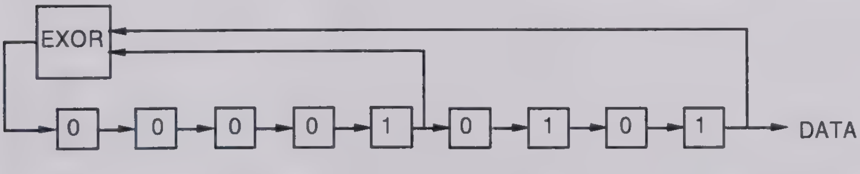
PRBS generator	**Length in bits**	**Feedback after**
9 bit	2^9 -1 = 511	Register 4, 0
11 bit	2^{11} -1 =2047	Register 2, 0
15 bit	2^{15} -1 = 32767	Register 1, 0
16 bit	2^{16} -1 = 65535	Register 5, 3, 2, 0
20 bit	2^{20} -1 = 1048575	Register 3, 0
21 bit	2^{21} -1 = 2097151	Register 2, 0
23 bit	2^{23} -1 = 8388607	Register 5, 0

PN generators PN9,11,15,20 and PN23 are configured according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generators PN15 and PN23.

The start value of the PN generators is different in the slots and equals

$$\text{start value} = 1 + 14\,\text{hex} \times \text{slot number}$$

Example: PN9 generator in slot 1 with start value 15hex = 10101 binary.



The resulting output sequence is `10101000000101001010111110010` etc.

2.11.3 Lists as Internal Data Source

A freely programmable memory on the data generator serves as internal data source for the data fields of the slots. The data are managed in so-called lists. A list editor allows to select, copy, modify and delete data lists (DATA LIST).
The list editor is available via menu DIGITAL-MOD - SOURCE....

2.11.4 External Modulation Data

External data can (only) be applied via the SERDATA interface. A selection of SERDATA as data source is only possible for a single data field of a slot. For further information on the characteristics of the SERDATA interface see Annex A.

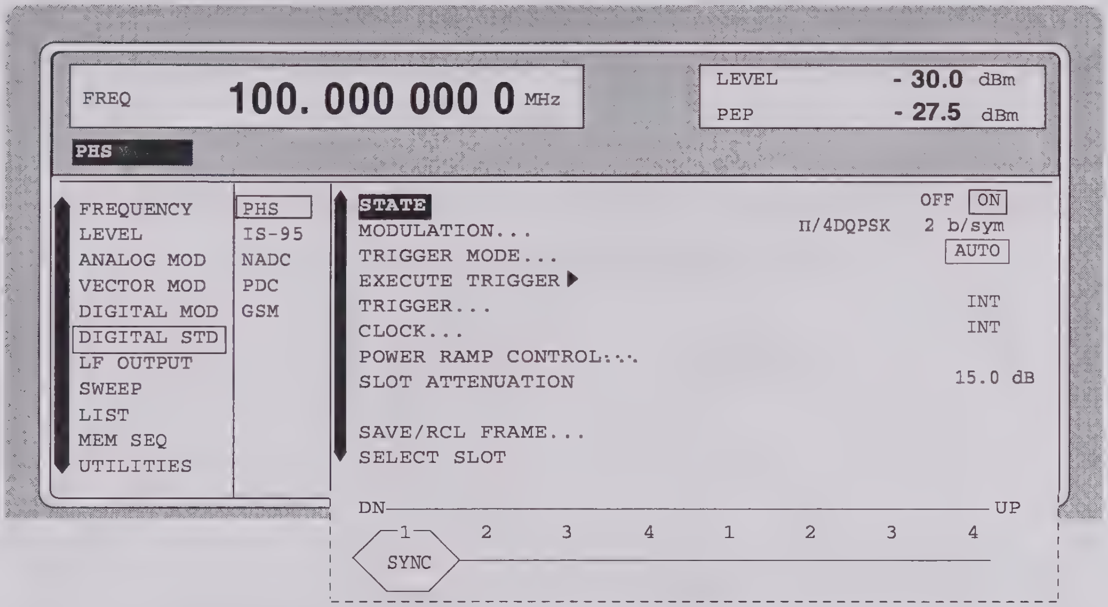
To ensure that the external data bits are assigned to specific positions in the data field of the selected slot and that they are reproducible, the buffer of the RS-232 transmitter and receiver has to be deleted. A triggered start has to follow.
The following setting sequence is required in the DIGITAL STD - PHS menu:

1. Carry out desired settings in menu.
2. Select data source SERDATA for the data field of the slot using SELECT SLOT - ....
3. Make connection to external data source, but do not yet start external data source.
4. Switch off digital standard using STATE - OFF.
5. Set TRIGGER MODE ARMED_AUTO.
   In this state, SMIQ is ready for reception, but discards data that are read in via SERDATA.
6. Switch on digital standard with STATE ON.
7. Start external data source.
   The read-in data are written into the receiving buffer. Only if this buffer is filled can SMIQ react to a trigger event.
8. Activate trigger event. Signal generation is thus started at a frame limit. The first bit received via SERDATA is put to the first bit position in the selected data field.

2.11.5 Menu DIGITAL STANDARD - PHS

Menu DIGITAL STD - PHS provides access to settings for generating PHS signals.

Menu selection: DIGITAL STD - PHS



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.5 dBm

STATE OFF ON

MODULATION... π/4DQPSK 2 b/sym

TRIGGER MODE... AUTO

TRIGGER... INT

CLOCK... INT

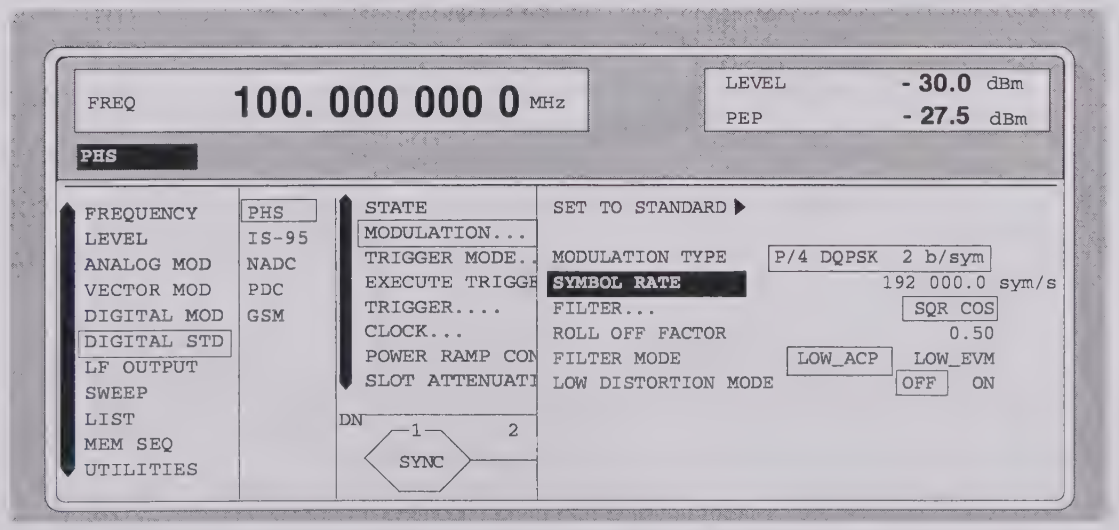
SLOT ATTENUATION 15.0 dB

Fig. 2-62 Menu DIGITAL STD - PHS, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

STATE Switch on/off of Digital Standard PHS modulation. Vector Modulation or Digital Modulation will be switched off automatically.

IEC/IEEE-bus command `:SOUR:PHS:STAT ON`

MODULATION... Opens a window for setting the modulation parameters.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.5 dBm

MODULATION TYPE P/4 DQPSK 2 b/sym

SYMBOL RATE 192 000.0 sym/s

FILTER... SQR COS

ROLL OFF FACTOR 0.50

FILTER MODE LOW_ACP LOW_EVM

LOW DISTORTION MODE OFF ON

Fig. 2-63 Menu DIGITAL STD - PHS - MODULATION..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(MODULATION...)	**SET TO STANDARD ▶**	Sets the subsequent modulation parameters to the values predefined by the standard.
	MODULATION TYPE	Displays the modulation type.
	SYMBOL RATE	Input value for the symbol rate. 192 ksymbol/s are preset. IEC/IEEE-bus `:SOUR:PHS:SRAT 192.01 KHZ`
	FILTER	Selection of baseband filter. A selection between Nyquist filters COS and SQRCOS is possible. IEC/IEEE-bus `:SOUR:PHS:FILT:TYPE COS`
	ROLL OFF FACTOR	Input value for the roll-off factor. IEC/IEEE-bus `SOUR:PHS:FILT:PAR 0.50`
	FILTER MODE	Selection of filter mode. LOW_ACP Filter for minimum Adjacent Channel Power. IEC `:SOUR:PHS:FILT:MODE LACP` LOW_EVM Filter for minimum vector error. IEC `:SOUR:PHS:FILT:MODE LEVM`
	LOW DISTORTION	Switch on/off of low-distortion mode.. After switch-on, the level of the IQ baseband signals is reduced by 3 dB. In some cases, this might reduce undesired intermodulation products. OFF is normally the more favourable setting. IEC/IEEE-bus command `:SOUR:PHS:LDIS OFF`
TRIGGER MODE...	Opens a window for selecting the trigger mode.	
	AUTO	The PHS signals are continuously transmitted in the activated slots. IEC/IEEE-bus command `:SOUR:PHS:SEQ AUTO`
	RETRIG	The PHS signals are continuously transmitted in the activated slots. A trigger event causes a restart. IEC/IEEE-bus command `:SOUR:PHS:SEQ RETR`
	ARMED_AUTO	The PHS signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus command `:SOUR:PHS:SEQ AAUT`
	ARMED_RETRIG	The PHS signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the RETRIG mode. Each new trigger event causes a restart. IEC/IEEE-bus command `:SOUR:PHS:SEQ ARET`

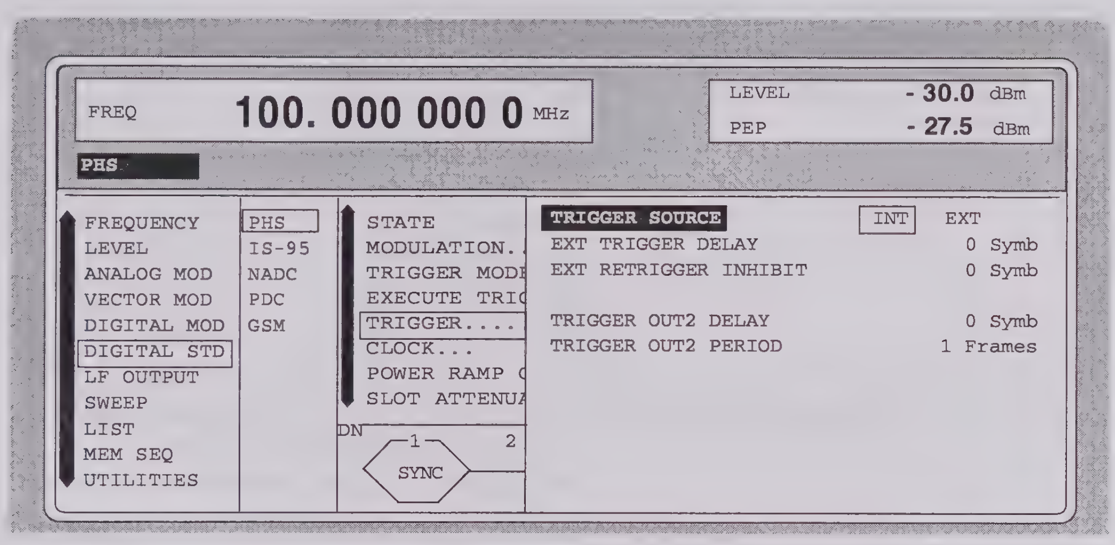
EXECUTE TRIGGER ▶

Executes a trigger even to start the PHS signal generation.

IEC/IEEE-bus command `:TRIG:DM:IMM`

TRIGGER...

Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.



```
FREQ     100. 000 000 0 MHz
LEVEL    - 30.0 dBm
PEP      - 27.5 dBm

TRIGGER SOURCE           INT  EXT
EXT TRIGGER DELAY          0 Symb
EXT RETRIGGER INHIBIT      0 Symb

TRIGGER OUT2 DELAY         0 Symb
TRIGGER OUT2 PERIOD        1 Frames
```

Fig. 2-64 Menu DIGITAL STD - PHS_TRIGGER..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(TRIGGER...) **TRIGGER SOURCE**

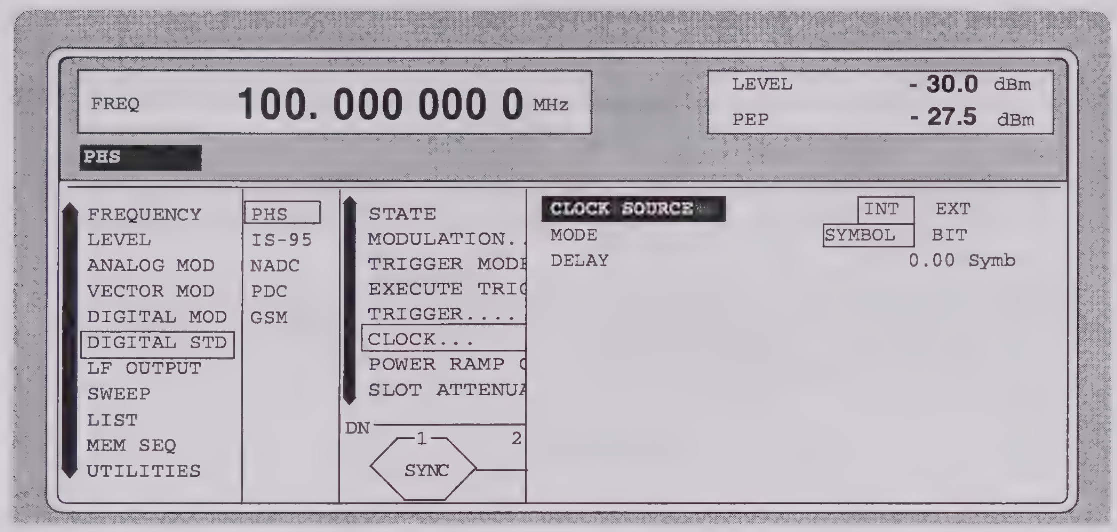
Selection of trigger source.

EXT	The PHS signal generation is started by the active slope of an external trigger signal. The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.
INT	A trigger event can be executed by EXECUTE TRIGGER ▶.

IEC/IEEE-bus `:SOUR:PHS:TRIG:SOUR EXT`

(TRIGGER...)	**EXT TRIGGER DELAY**	Setting the number of symbols by which an external trigger signal is delayed before it starts the PHS signal generation. This is used for setting the time synchronization between the the SMIQ and the DUT. IEC/IEEE-bus command `:SOUR:PHS:TRIG:DEL 3`
	EXT RETRIGGER INHIBIT	Setting the number of symbols for which a restart is inhibited after a trigger event. With TRIGGER MODE RETRIG selected, each new trigger signal restarts the PHS signal generation. This restart can be inhibited for the entered number of symbols. Example: The entry of 1000 symbols causes new trigger signals to be ignored for the duration of 1000 symbols after a trigger event IEC/IEEE-bus `:SOUR:PHS:TRIG:INH 1000`
	TRIGGER OUT 2 DELAY	Input value of delay of trigger signal at TRIGOUT 2 output compared with beginning of frame. IEC/IEEE-bus `:SOUR:PHS:TRIG:OUTP:DEL 2`
	TRIGGER OUT2 PERIOD	Input value of output signal period at TRIGOUT 2 output given in frames. IEC/IEEE-bus `:SOUR:PHS:TRIG:OUTP:PER 1`

CLOCK... Opens a window for selecting the clock source and for setting a delay.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.5 dBm

CLOCK SOURCE INT

MODE SYMBOL

DELAY 0.00 Symb

Fig. 2-65 Menu DIGITAL STD - PHS - CLOCK..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(CLOCK...)

CLOCK SOURCE Selection of clock source.

INT SMIQ uses internally generated clock signals.

EXT An external symbol clock or bit clock is fed in at connectors SYMBOL CLOCK or BIT CLOCK. The clock synthesizer on the modulation coder is synchronized to this clock.
The symbol rate has to be set with an accuracy of ± 1 %.
The polarity, the trigger threshold and the input resistance of the clock inputs can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus command `:SOUR:PHS:CLOC:SOUR INT`

MODE Selection of clock for external clock signal.

SYMBOL The external clock has to be a symbol clock.

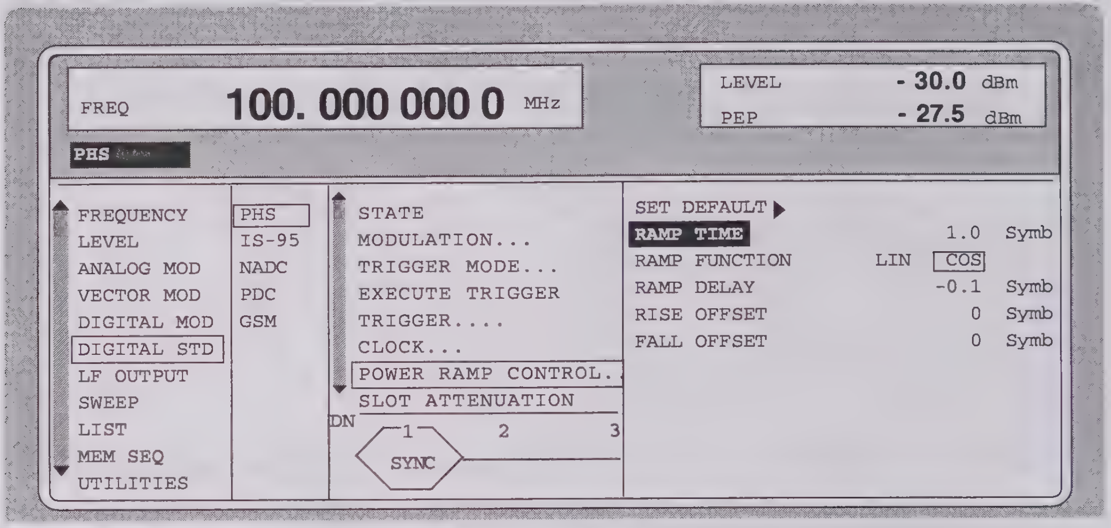
BIT The external clock has to be a bit clock.

IEC/IEEE-bus command `:SOUR:PHS:CLOC:MODE SYMB`

DELAY Setting the delay of generated modulation signal to an external clock.
This can be used, for example, for synchronization with a second unit to achieve time synchronization between the modulation signals of the two units.

IEC/IEEE-bus command `:SOUR:PHS:CLOC:DEL 0.5`

POWER RAMP CONTROL... Opens a window for setting the envelope control, especially for the rising and falling ramp at the beginning and end of a slot.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.5 dBm

SET DEFAULT ▶

RAMP TIME 1.0 Symb

RAMP FUNCTION LIN [✓ COS]

RAMP DELAY -0.1 Symb

RISE OFFSET 0 Symb

FALL OFFSET 0 Symb

Fig. 2-66 Menu DIGITAL STD - PHS - POWER RAMP CONTROL... , SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(POWER RAMP CONTROL...)

SET DEFAULT ▶ Resets the subsequent parameters to the factory-set values.
IEC/IEEE-bus `:SOUR:PHS:PRAM:PRES`

RAMP TIME Input value for the rise and fall time of the envelope at the beginning or end of a slot. The time is set in units of symbol period.
IEC/IEEE-bus `:SOUR:PHS:PRAM:TIME 0.25`

RAMP FUNCTION Selection of shape of rising and falling ramp for envelope control.

LIN	Linear ramp function.
COS	Cosine function. A more favourable spectrum than that of the LIN function is obtained.

IEC/IEEE-bus `:SOUR:PHS:PRAM:SHAP LIN`

RAMP DELAY Input value for a shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope. The values are set in the units of the symbol length.
IEC/IEEE-bus `:SOUR:PHS:PRAM:DEL 0.1`

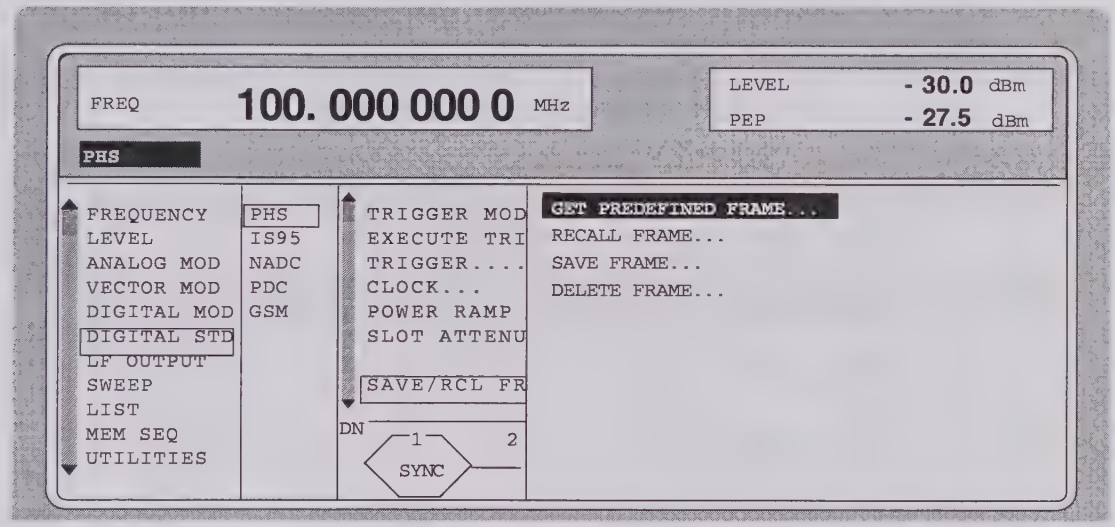
RISE OFFSET Input value for a positive or negative offset of the rising ramp of the envelope at the beginning of a slot.
IEC/IEEE-bus `:SOUR:PHS:PRAM:ROFF -1`

FALL OFFSET Input value for a positive or negative offset of the falling ramp of the envelope at the end of a slot.
IEC/IEEE-bus `:SOUR:PHS:PRAM:FOFF 1`

SLOT ATTENUATION Input value for the level reduction in dB of all active slots whose SLOT LEVEL was set to ATTEN. Menu SELECT SLOT allows the slots to be determined whose level is to be reduced.

IEC/IEEE-bus command `:SOUR:PHS:SLOT:ATT 40 DB`

SAVE/RCL FRAME... Opens a window for saving and loading a frame configuration. Loading a frame affects all parameters that can be set under SELECT SLOT.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.5 dBm

Fig. 2-67 Menu DIGITAL STD - PHS - SAVE/RCL FRAME, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SAVE/RCL FRAME...) **GET PREDEFINED FRAME...** Loads a factory-set frame configuration.

DN1_TCH	Downlink Traffic Channel in slot1
UP1_TCH	Uplink Traffic Channel in slot1
DN1_SYNC	Downlink Sync Channel in slot1

IEEE `:SOUR:PHS:FLIS:PRED:LOAD "DN1_TCH"`

RECALL FRAME... Loads a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:PHS:FLIS:LOAD "name"`

SAVE FRAME... Saves a user-defined frame configuration.

IEC/IEEE-bus `:SOUR:PHS:FLIS:STOR "name"`

DELETE FRAME... Deletes a frame configuration saved by the user.

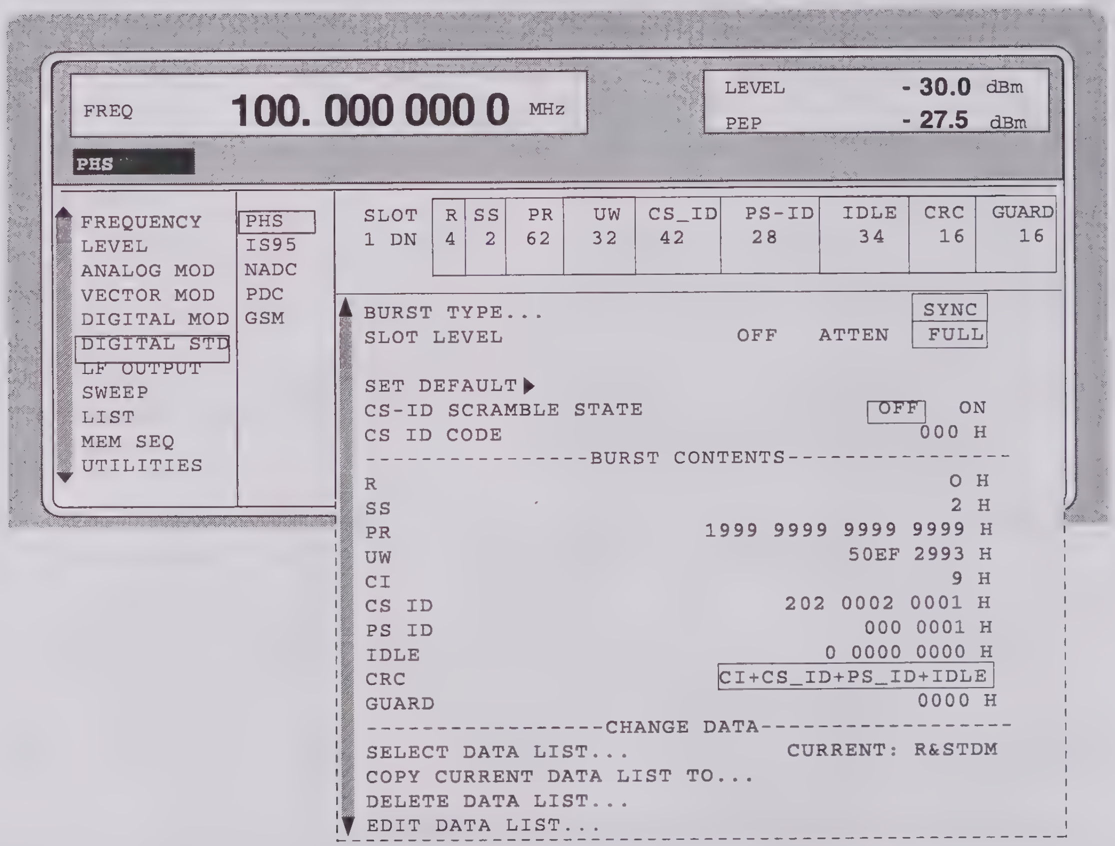
IEC/IEEE-bus `:SOUR:PHS:FLIS:DEL "name"`

SELECT SLOT...

Selection of one of 8 possible slots. When selecting the slot, a window is opened in which the data contents belonging to this slot can be defined.
4 slots are available for uplink and downlink. They are designated as UP<i> and DN<i> in the display. For remote control, the slots are numbered from 1 to 8. The following assignment applies:

Slot	DN1	DN2	DN3	DN4	UP1	UP2	UP3	UP4
Slot number	1	2	3	4	5	6	7	8

If the cursor is placed onto a slot in the diagram, it may be switched on and off by pressing one of the unit keys (toggle function).



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm
PEP - 27.5 dBm

SLOT	R	SS	PR	UW	CS_ID	PS-ID	IDLE	CRC	GUARD
1 DN	4	2	62	32	42	28	34	16	16

```
BURST TYPE...                                  SYNC
SLOT LEVEL                    OFF    ATTEN     FULL

SET DEFAULT ▶
CS-ID SCRAMBLE STATE                       OFF   ON
CS ID CODE                                   000 H
---------------BURST CONTENTS---------------
R                                              0 H
SS                                             2 H
PR                           1999 9999 9999 9999 H
UW                                     50EF 2993 H
CI                                             9 H
CS ID                             202 0002 0001 H
PS ID                                 000 0001 H
IDLE                                0 0000 0000 H
CRC                          CI+CS_ID+PS_ID+IDLE
GUARD                                     0000 H
----------------CHANGE DATA-----------------
SELECT DATA LIST...              CURRENT: R&STDM
COPY CURRENT DATA LIST TO...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-68 Menu DIGITAL STD - PHS - SELECT SLOT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT)

BURST TYPE... Opens a window for the selection of the burst type used to configure the selected slot.

TCH_FULL Traffic channel configuration (rate 32 kbit/s)
IEEE-bus `:SOUR:PHS:SLOT2:TYPE TCHF`

TCH_HALF Traffic channel configuration (rate 16 kbit/s)
IEEE-bus `:SOUR:PHS:SLOT2:TYPE TCHH`

VOX VOX configuration. In slots 4 to 8 (uplink) transmission is only in every fourth frame.
IEEE-bus `:SOUR:PHS:SLOT2:TYPE VOX`

SYNC Sync burst
IEEE-bus `:SOUR:PHS:SLOT2:TYPE SYNC`

ALL DATA Burst type for testing with freely programmable data contents
IEEE-bus `SOUR:PHS:SLOT2:TYPE ADAT`

SLOT LEVEL Selection of level for selected slot.

OFF Maximum attenuation
IEEE bus `:SOUR:PHS:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.
IEEE bus `:SOUR:PHS:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.
IEEE bus `:SOUR:PHS:SLOT2:LEV ATT`

SET DEFAULT ▶ Resets the subsequent parameters to the factory-set values.
IEC/IEEE-bus command `:SOUR:PHS:SLOT8:PRES`

CS-ID SCRAMBLE STATE Switch on/off of CS-ID scrambling function.
IEC/IEEE-bus `:SOUR:PHS:SLOT2:SCR:STAT ON`

CS-ID CODE Input value in hexadecimal form for initializing the scramble generator.
IEEE-bus `:SOUR:PHS:SLOT2:SCR:CODE #H123`

ENCRYPTION STATE Switch on/off of encryption scrambling function. This parameter is only available for TCH burst types.
IEC/IEEE-bus `:SOUR:PHS:SLOT2:ENCR:STAT ON`

SECURITY KEY Input value in hexadecimal form for initializing the scramble generator. This parameter is only available for TCHburst types.
IEEE-bus `:SOUR:PHS:SLOT2:ENCR:KEY #H1234`

(SELECT SLOT)

R
Display of data contents in the 4-bit data field "Ramp".

SS
Display of data contents in the 2-bit data field "Start Symbol".

PR
Display of "Preamble".

UW
Input value for the "Unique Word" in hexadecimal form.
IEC/IEEE-bus `:SOUR:PHS:SLOT2:UWOR #H3D4C`

CI
Display of the "Channel Identifier" data field in hexadecimal form.

SA
Selection of data source for SACCH. This data field is only displayed for burst types TCH and VOX.

PN..	PRBS data according to CCITT V52 or Rec. 0.151 with periods between 2^9-1 and 2^{23}-1. IEEE `:SOUR:PHS:SLOT3:SACCH PN9`
DLIST	Data from a programmable data list. IEEE `:SOUR:PHS:SLOT3:SACCH DLIS`
SERDATA	Data from data input SER DATA IEEE `:SOUR:PHS:SLOT3:SACCH SDAT`

TCH / VOX
Selection of data source for TCH data field. This data field is only displayed for burst types TCH and VOX.

PN..	PRBS data according to CCITT V52 or Rec. 0.151 with periods between 2^9-1 and 2^{23}-1. IEEE `:SOUR:PHS:SLOT3:TCH PN9`
DLIST	Data from a programmable data list. IEEE `:SOUR:PHS:SLOT3:TCH DLIS`
SERDATA	Data from data input SER DATA IEEE `:SOUR:PHS:SLOT3:TCH SDAT`

CS-ID
Input value for the "Cell Station ID Code" field in hexadecimal form. This data field is only displayed for the burst type SYNC.
IEEE-bus `:SOUR:PHS:SLOT2:CSID #H20200020001`

(SELECT SLOT)	**PS-ID**	Input value for the "Personal Station ID Code" field in hexadecimal form. This data field is only displayed for the burst type SYNC. IEEE-bus `:SOUR:PHS:SLOT2:PSID #H0000001`
	IDLE	Display of data contents in the "Idle" field. This field is only displayed for the burst type SYNC.
	CRC	Indication of data fields for calculating the CRC code.
	GUARD	Display of data contents in the "Guard" field in hexadecimal form.
	SELECT DATA LIST...	Opens a window for selecting a stored data list or for generating a new list.
	COPY CURRENT DATA LIST TO...	Stores the current data list under a different name.
	DELETE DATA LIST...	Deletes a data list.
	EDIT DATA LIST...	Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

2.12 Digital Standard IS-95 CDMA

With the options Modulation Coder (SMIQB20), Data Generator (SMIQB11) and option Digital Standard CDMA (SMIQB42) provided, CDMA signals can be generated according to standard IS-95[1] as well as J-STD-008.

SMIQ can simulate both the transmit signal of a base station (forward link) and the transmit signal of a mobile station (reverse link). The forward link signal consists of up to 64 code channels. A reverse link signal can be generated in the full-rate or half-rate mode.

Simple bit patterns or pseudo random bit sequences (PRBS) can be selected as modulation data for forward link. Every code channel has a different PRBS. Modulation data are not subject to channel coding (convolution coding, interleaving).

The following figure shows the schematic of forward link signal generation.

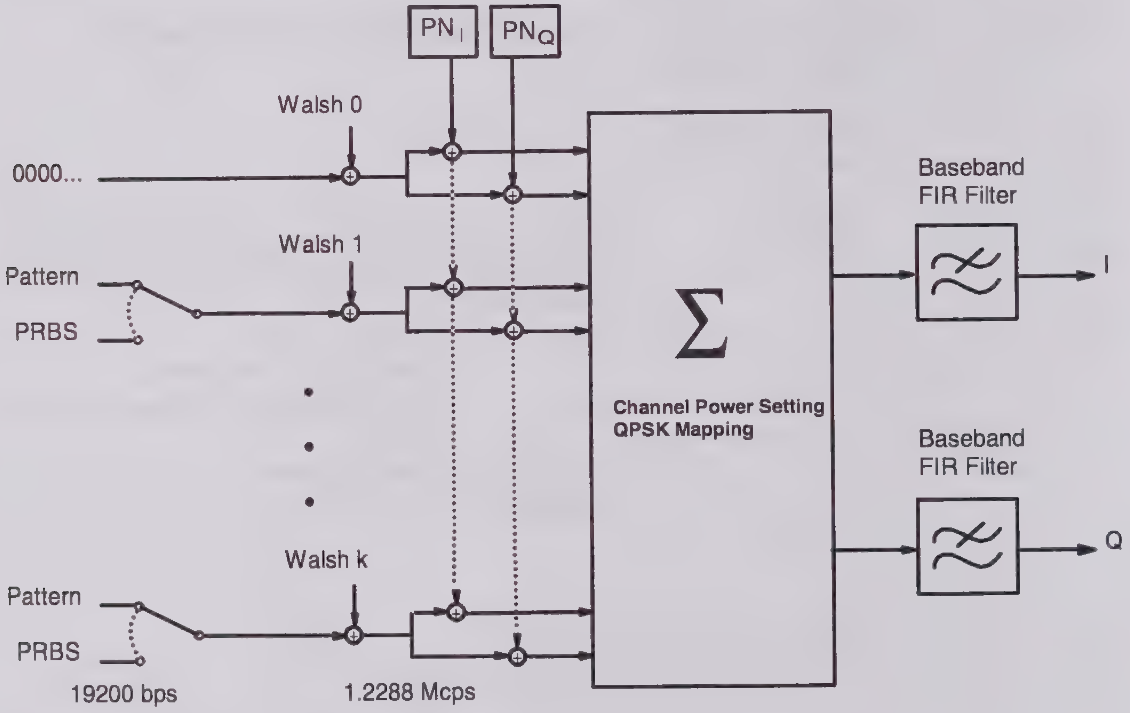


Fig. 2-69 Forward link signal generation

At a chip rate of 1.2288 Mcps, the modulation data rate for forward link is 19200 bp/s for all channels. The modulation type is QPSK. For baseband filtering, a FIR filter with equalizer is preset according to IS-95 (FILTER TYPE IS-95 EQUAL). Other filters can be set as well. The chip rate is preset to 1.2288 Mcps according to IS-95 but can be freely selected.

---

[1] TIA/EIA/IS-95, Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems

To generate a reverse link signal, two different operating modes are available. The following figure shows the schematic of reverse link signal generation without channel coding.

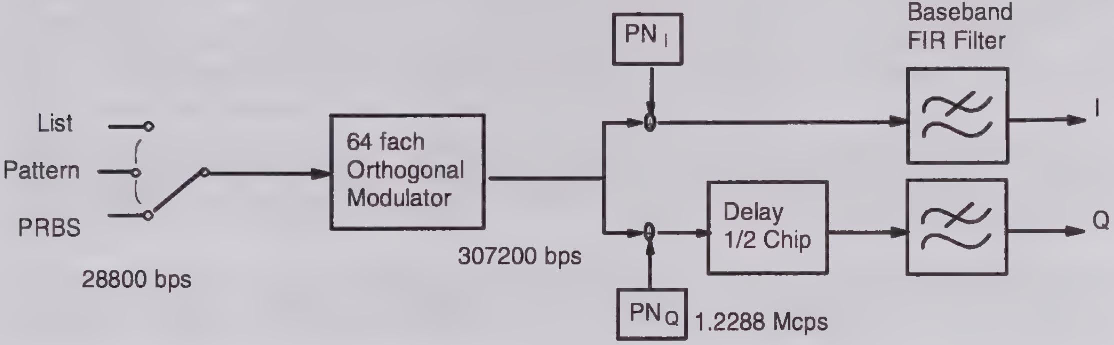


Fig. 2-70 Reverse link signal generation without channel coding

Simple bit patterns, PRBS and freely programmable data sequences in a data list are available as modulation data. At a chip rate of 1.2288 MHz, the modulation data rate of the reverse link is 28800 bps/s. The modulation type is offset-QPSK. A FIR filter is preset as baseband filter without equalizer according to IS-95 (FILTER TYPE IS-95).

The second reverse link mode also comprises channel coding. With this reverse link coded mode, both an access channel (4800 bps) and a traffic channel can be generated with all the data rates between 1200 bps and max. 14400 bps complying with IS-95 (Rate Set 1 and 2). The following figure gives an example of signal generation for the traffic channel with 9600 bps and shows the associated frame structure.

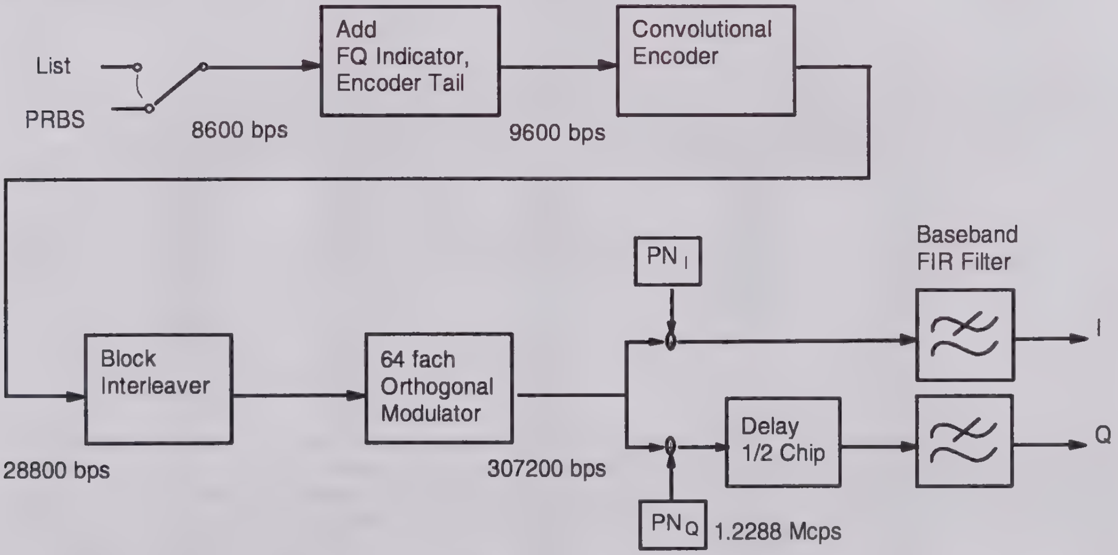


Fig. 2-71 Traffic channel 9600 in "Reverse Link Coded" mode

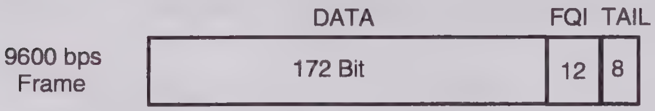


Fig. 2-72 Frame structure of traffic channel 9600 in "Reverse Link Coded" mode

PRBS of different lengths and a list of freely programmable data sequences are available as modulation data. In the reverse link coded mode, MIQ generates a test signal for BER and FER easurements at a base station receiver. A special ervice mode is required for the DUT since the long code is set to 0 in the SMIQ test signal.

To facilitate operation, the following tables show the frequency channels according to regulations IS-95 and J-STD-008. The tables are also available on the SMIQ display via the HELP function for IS-95 menu selection.

Table 2-14 CDMA: channel numbers and their frequencies

IS-95	**channel number**	**generator frequency /MHz**
Mobile station	$1 \leq N \leq 777$ $1013 \leq N \leq 1023$	0.03N + 825.0 0.03(N-1023)+825.0
Base station	$1 \leq N \leq 777$ $1013 \leq N \leq 1023$	0.03N + 870.0 0.03(N-1023)+870.0

J-STD-008	**channel number**	**generator frequency/MHz**
Mobile station	$1 \leq N \leq 1199$	0.050N + 1850.000
Base station	$1 \leq N \leq 1199$	0.050N + 1930.000

Table 2-15 Preferred CDMA-frequency channels according to J-STD-008

channel number	**generator-frequency/MHz**	
	mobile station	**base station**
25	1851.25	1931.25
50	1852.50	1932.50
75	1853.75	1933.75
100	1855.00	1935.00
125	1856.25	1936.25
150	1857.50	1937.50
175	1858.75	1938.75
200	1860.00	1940.00
225	1861.25	1941.25
250	1862.50	1942.50
275	1863.75	1943.75
325	1866.25	1946.25
350	1867.50	1947.50
375	1868.75	1948.75
425	1871.25	1951.25
450	1872.50	1952.50
475	1873.75	1953.75
500	1875.00	1955.00
525	1876.25	1956.25
550	1877.50	1957.50
575	1878.75	1958.75
600	1880.00	1960.00
625	1881.25	1961.25
650	1882.50	1962.50
675	1883.75	1963.75
725	1886.25	1966.25
750	1887.50	1967.50
775	1888.75	1968.75
825	1891.25	1971.25
850	1892.50	1972.50
875	1893.75	1973.75
925	1896.25	1976.25
950	1897.50	1977.50
975	1898.75	1978.75
1000	1900.00	1980.00
1025	1901.25	1981.25
1050	1902.50	1982.50
1075	1903.75	1983.75
1100	1905.00	1985.00
1125	1906.25	1986.25
1150	1907.50	1997.50
1175	1908.75	1988.75

2.12.1 Sync and Trigger Signals

A CDMA sequence with a length of 98304 chips is calculated for the generation of forward link CDMA signals and stored in the memory of the data generator (option SMIQB11). This chip sequence can be run repetitively (TRIGGER MODE AUTO). During reverse link signal generation with channel coding, the modulation data are continuously processed in real time.
Trigger signals can be used for synchronized measurements on receivers.

A trigger signal can be fed via the TRIGIN input at connector PAR DATA. The chip sequence either starts immediately after the active slope of the trigger signal or after a settable number of chips (TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a settable number of chips (TRIGGER INHIBIT).

A trigger event can be executed manually or via the IEC/IEEE bus using EXECUTE TRIGGER. When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ also generates the following sync signals:

- a 20-ms frame clock (traffic channel frame clock)
- a 80/3-ms clock (short sequence rollover)
- a 80-ms clock (super frame clock))
- a 2-s clock (even second clock)
- a PCG clock in reverse link at half rate, 1/4 rate and 1/8 rate

SMIQ can output two of the four signals via pins TRIGOUT 1 and 2 of connector PAR DATA.

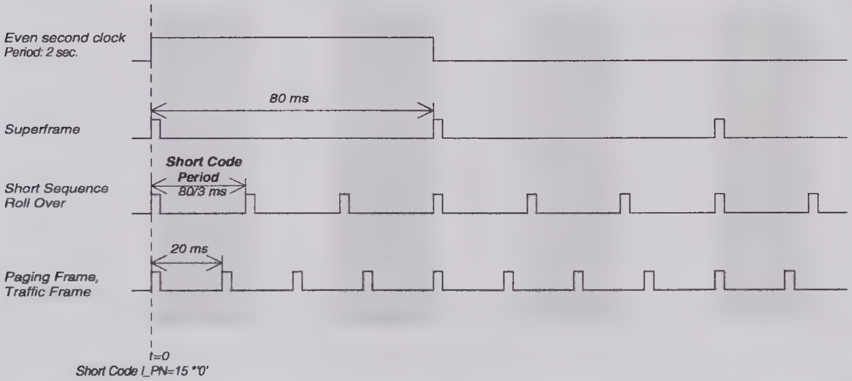


Fig. 2-73 CDMA sync signals

A clock synthesizer on the modulation coder generates the chip clock and a multifold chip clock in the SMIQ. All the clock signals are synchronized to the 10-MHz reference of the SMIQ. The chip clock is available at connector SYMBOL CLOCK and the multifold chip clock at connector BIT CLOCK. If required, the clock synthesizer in the SMIQ can be synchronized to an external chip clock which is fed in at connector SYMBOL CLOCK.

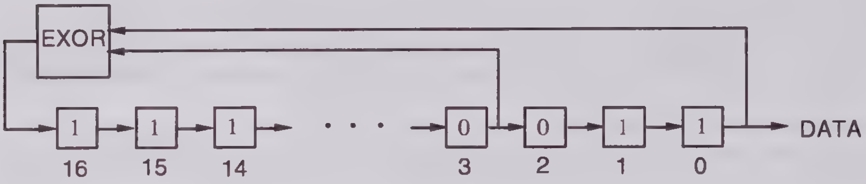
The clock signal is selected in the menu via CLOCK-CLOCK SOURCE EXT.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Note: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.12.2 PRBS Data Source in Forward Link

A PN generator is used as PRBS data source for forward link modes. This PN generator provides a pseudo random bit sequence with a period of 2^{17}-1. The PRBS data sequence is a so-called sequence of maximum length that is generated by means of a feedback shift register. The following schematic shows the PN generator with feedback to registers 3 and 0 (output). The data of the start value are entered into the register.



The start value of the PN generator is `1100 0100 1110 0011 1`
The bit sequence after the start thus is:

```
    1100 0100 1110 0011 1111 0001 1111 1110...
... 0011 1111 0000 0111 1110 0011 1001 1100...
... 0111 1111 1011 1111 1100 0001 0010 0000...
... 1110 0100 0001 0011 1110 0010 0100 0110.........
```

The generated bits are assigned to the modulation data of the different forward link modes as follows:

Mode FWD_LINK_18
The PN bits are assigned to the different code channels as follows:

Modulation data bit 0:
```
1100 0100 1110 0011 1111 0001 1111 1110 ...
↑                                     ↑
c31, ch30, .........................ch0 ...
```
Modulation data bit 1:
```
0011 1111 0000 0111 1110 0011 1001 1100 ...
↑                                     ↑
ch31, ch30, ........................ch0 ...
```
etc.

The data bits of the unused code channels c18 to c31 and those of the deactivated code channels are discarded, ie not used.

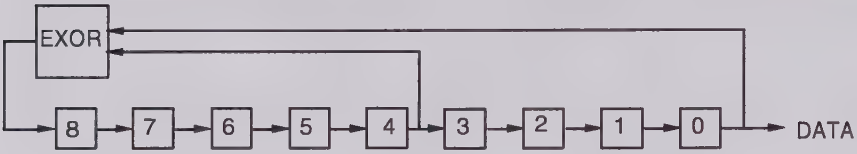
Modus FWD_LINK_64
The PN bits are assigned to the different code channels as follows:

Modulation data bit 0:
```
11000100111000111111000111111110 00111111000001111110001110011100 ...
↑                              ↑ ↑                              ↑
c31, ch30, ..................ch0,ch63, ch62, ................ch32 ...
```
Modulation data bit 1:
```
01111111101111111100000100100000.11100100000100111110001001000110 ...
↑                              ↑ ↑                              ↑
c31, ch30, ..................ch0,ch63, ch62, ................ch32 ...
```
etc.

The data bits of the deactivated code channels are discarded, ie not used.

2.12.3 PN Generators as Internal Data Source for Reverse Link

Different PN (Pseudo Noise) generators can be selected as data source for modulation data in the two reverse link modes. These PN generators provide pseudo random bit sequences of different lengths or periods which is why they are also called PRBS generators (Pseudo Random Binary Sequence).
The data sequences are so-called sequences of maximum lengths that are generated by means of feedback shift registers.
The following schematic shows the 9 bit generator with feedback to registers 4 and 0 (output).



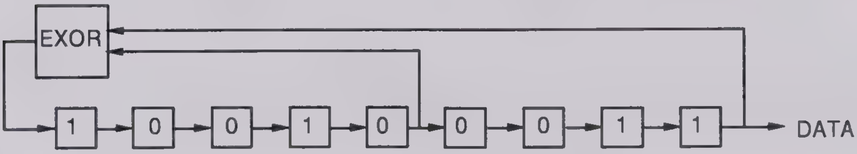
The pseudo random sequence of a PRBS generator is determined by the number of registers and the feedback. The following table describes all available PRBS generators:

Table 2-16 PN generators for IS-95 reverse link

PRBS generator	**Length in bits**	**Feedback to**	**Start value**
9 bits	2^{9} -1 = 511	Register 4, 0	1100 0100 1
11 bits	2^{11} -1 =2047	Register 2, 0	1100 0100 111
15 bits	2^{15} -1 = 32767	Register 1, 0	1100 0100 1110 001
16 bits	2^{16} -1 = 65535	Register 5, 3, 2, 0	1100 0100 1110 0011
20 bits	2^{20} -1 = 1048575	Register 3, 0	1100 0100 1110 0011 1111
21 bits	2^{21} -1 = 2097151	Register 2, 0	1100 0100 1110 0011 1111 0
23 bits	2^{23} -1 = 8388607	Register 5, 0	1100 0100 1110 0011 1111 000

PN generators PN9,11,15,20 and PN23 are designed according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generators PN15 and PN23.

Example: PN9 generator in slot 1 with start value 110001001 (binary)

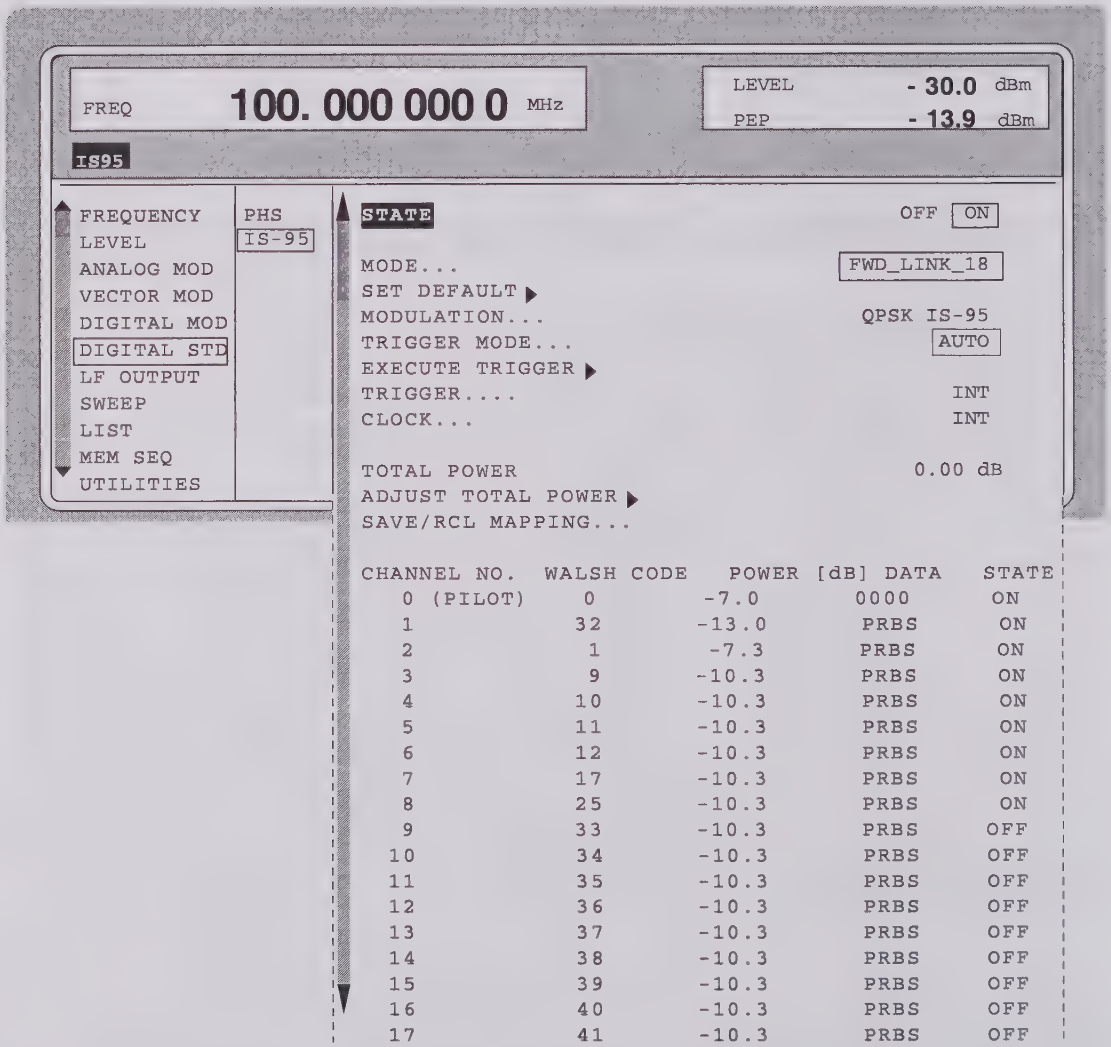


The resulting output sequence is `110001001100010001000` etc.

2.12.4 Menu IS-95 CDMA Standard - Forward Link Signal

Menu DIGITAL STD - IS-95 provides access to settings for IS-95 CDMA signal generation. The following figure shows the menu for generating the forward link signal (transmit signal of base station) in the FWD_LINK_18 mode. The menus for generating reverse link signals are described in the following section. Parameters that are identical for both modes are explained in the menu for forward link.

Menu selection: DIGITAL STD - IS-95- MODE - FWD_LINK_18



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 13.9 dBm

STATE OFF ON

MODE... FWD_LINK_18

MODULATION... QPSK IS-95

TRIGGER MODE... AUTO

TRIGGER.... INT

CLOCK... INT

TOTAL POWER 0.00 dB

CHANNEL NO.	WALSH CODE	POWER [dB]	DATA	STATE
0 (PILOT)	0	-7.0	0000	ON
1	32	-13.0	PRBS	ON
2	1	-7.3	PRBS	ON
3	9	-10.3	PRBS	ON
4	10	-10.3	PRBS	ON
5	11	-10.3	PRBS	ON
6	12	-10.3	PRBS	ON
7	17	-10.3	PRBS	ON
8	25	-10.3	PRBS	ON
9	33	-10.3	PRBS	OFF
10	34	-10.3	PRBS	OFF
11	35	-10.3	PRBS	OFF
12	36	-10.3	PRBS	OFF
13	37	-10.3	PRBS	OFF
14	38	-10.3	PRBS	OFF
15	39	-10.3	PRBS	OFF
16	40	-10.3	PRBS	OFF
17	41	-10.3	PRBS	OFF

Fig. 2-74 Menu DIGITAL STD - IS-95 - MODE - FWD_LINK_18, equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB42

STATE Switch on/off of modulation Digital Standard IS-95 CDMA. Vector modulation and digital modulation will be switched off automatically.

IEC/IEEE-bus command `SOUR:IS95:STAT ON`

MODE...

Selection between the different modes for generating a forward link signal or reverse link signals. The REV_LINK modes will be described in the following sections.

FWD_LINK_18	Activates the generation of a forward link signal with up to 18 code channels (channel No. 0 to 17). The Walsh code (WALSH CODE) and the source for modulation data (DATA) can be determined individually for each channel. Each channel can be switched on/off (STATE). The relative power (POWER) of channels 0 (pilot), 1 and 2 can be freely determined in range -30 dB to 0 dB. The power setting of channel 3 also determines the power setting of channels 4 to 17. This means that channels 3 to 17 all have the same power provided when the channels are switched on. IEC/IEEE-bus `:SOUR:IS95:MODE FLIN18`
FWD_LINK_64	Activates the generation of a forward link signal with up to 64 code channels. Walsh codes 0 to 63 (WALSH CODE) are assigned to the channels. The source for modulation data (DATA) can be determined individually for each channel. Each channel can be switched on/off (STATE). The relative power (POWER) of the pilot channel (Walsh 0) can be freely determined in range -30 dB to 0 dB. The power setting of channel 1 also determines the power setting of channels 2 to 63. This means that channels 1 to 63 all have the same power provided when the channels are switched on. IEC/IEEE-bus `:SOUR:IS95:MODE FLIN64`
REV_LINK	Activates the generation of a reverse link signal without channel coding. A selection between the full-rate and half-rate mode (RATE) is possible. IEC/IEEE-bus `:SOUR:IS95:MODE RLIN`
REV_LINK_CODED	Activates the generation of a reverse link signal with channel coding. A selection between the access channel and traffic channel with different rates is possible. IEC/IEEE-bus `:SOUR:IS95:MODE RLCO`

SET DEFAULT ▶ Provides the default setting for the channel configuration of the forward link modes.

For FWD_LINK_18:

- channels 0 to 8 are switched on
- the power of the pilot channel (channel 0) makes out 20% of the total power (-7 dB).
- channel 1 is set as sync channel by WALSH CODE 32
- channel 2 is set as paging channel
- the remaining 7 channels are configured as traffic channels

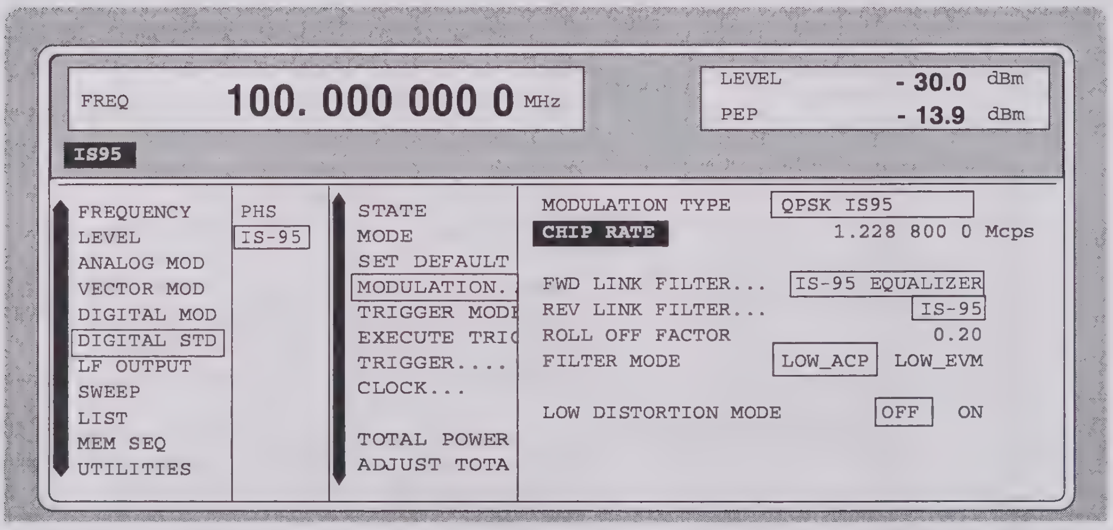
  The power setting was selected according to the "Base Station Test Model" of TIA standard IS-97.

For FWD_LINK_64:

- all 64 channels are switched on
- the power of the pilot channel makes out 20% of the total power (-7 dB).
- the remaining 80% of the transmit power is distributed equally on the remaining 63 channels.

IEC/IEEE-bus command `:SOUR:IS95:PRES`

MODULATION... Opens a window for setting the modulation parameters.



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 13.9 dBm
MODULATION TYPE QPSK IS95
CHIP RATE 1.228 800 0 Mcps
FWD LINK FILTER... IS-95 EQUALIZER
REV LINK FILTER... IS-95
ROLL OFF FACTOR 0.20
FILTER MODE LOW_ACP LOW_EVM
LOW DISTORTION MODE OFF ON

Fig. 2-75 Menu DIGITAL STD - IS-95 - MODULATION..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB42

(MODULATION...) **MODULATION TYPE** Indicates the modulation type.

CHIP RATE Setting value of chip clock frequency.
Preset to 1.2288 Mcps.

IEEE-bus command `:SOUR:IS95:CRAT 1.2 MHZ`

(MODULATION...)

FWD LINK FILTER...

Opens a window for selecting the baseband filters for the forward link.
A selection between the FIR filters defined in IS-95 or the Nyquist filters COS and SQRCOS is possible. A FIR filter is preset with equalizer according to IS-95.

IEEE command `:SOUR:IS95:FILT:FTYP EIS95`

REV LINK FILTER...

Opens a window for selecting the baseband filter for the reverse link.
A selection between the FIR filters defined in IS-95 or the Nyquist filters COS and SQRCOS is possible. A FIR filter is preset according to IS-95.

IEEE command `:SOUR:IS95:FILT:RTYP IS95`

ROLL OFF FACTOR

Setting value of roll-off factor.
The setting is only possible provided that a COS or SQRCOS filter is selected under FILTER.

IEEE-bus command `:SOUR:IS95:FILT:PAR 0.22`

FILTER MODE

Selection of filter mode.

LOW_ACP	Filter for minimum Adjacent Channel Power. IEEE `SOUR:IS95:FILT:MODE LACP`
LOW_EVM	Filter for minimum vector error. IEEE `SOUR:IS95:FILT:MODE LEVM`

LOW DISTORTION MODE

Switch on/off of low-distortion mode.
After switch-on, the level of the IQ baseband signals is reduced by 3 dB. In some cases, this might reduce undesired intermodulation products. OFF is normally the more favourable setting.

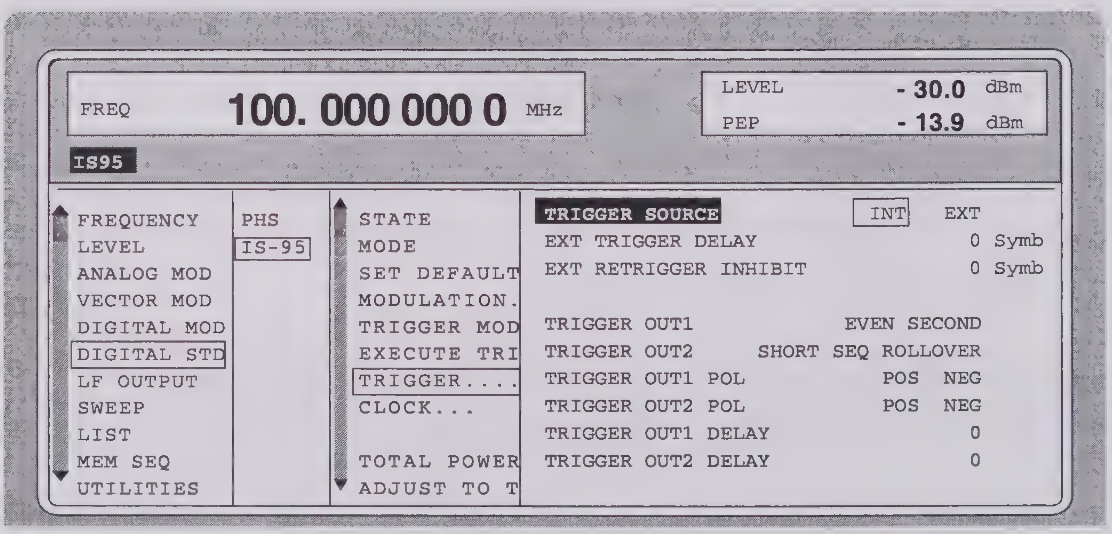
IEC/IEEE-bus command `:SOUR:IS95:LDIS OFF`

TRIGGER MODE... Opens a window for selecting the CDMA sequence.

AUTO	The calculated CDMA chip sequence is cyclically repeated. IEC/IEEE-bus command `:SOUR:IS95:SEQ AUTO`
RETRIG	The CDMA chip sequence is continuously repeated. A trigger event causes a restart from frame 1. IEC/IEEE-bus command `:SOUR:IS95:SEQ RETR`
ARMED_AUTO	The CDMA chip sequence cannot be started from frame 1 until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus command `:SOUR:IS95:SEQ AAUT`
ARMED_RETRIG	The CDMA chip sequence cannot be started from frame 1 until a trigger event has occurred. each new trigger event causes a restart. IEC/IEEE-bus command `:SOUR:IS95:SEQ ARET`

EXECUTE TRIGGER ▶ Executes a trigger event to start the CDMA chip sequence.
IEC/IEEE-bus command `:TRIG:DM:IMM`

TRIGGER... Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.


FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 13.9 dBm

```
TRIGGER SOURCE              INT   EXT
EXT TRIGGER DELAY                0 Symb
EXT RETRIGGER INHIBIT            0 Symb

TRIGGER OUT1           EVEN SECOND
TRIGGER OUT2     SHORT SEQ ROLLOVER
TRIGGER OUT1 POL          POS   NEG
TRIGGER OUT2 POL          POS   NEG
TRIGGER OUT1 DELAY               0
TRIGGER OUT2 DELAY               0
```

Fig. 2-76 Menu DIGITAL STD - IS-95 - TRIGGER..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB42

(TRIGGER...)

TRIGGER SOURCE

Selection of trigger source.

EXT	The CDMA chip sequence is started from frame 1 by means of the active slope of an external trigger signal. The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.
INT	A trigger event is manually executed by EXECUTE TRIGGER.

IEC/IEEE-bus `:SOUR:IS95:TRIG:SOUR EXT`

EXT TRIGGER DELAY

Setting the number of chips (symbols) by which an external trigger signal is delayed before it starts the CDMA chip sequence.

This is used for setting the time synchroneity between the DUT and other units.

IEC/IEEE-bus `:SOUR:IS95:TRIG:DEL 3`

EXT RETRIGGER INHIBIT

Setting the number of chips for which a restart is inhibited after a trigger event.
With TRIGGER MODE RETRIG selected, each new trigger signal restarts the CDMA chip sequence. This restart can be inhibited for the entered number of chips (symbols).

Example:
The entry of 98000 symbols, for example, causes new trigger signals to be ignored for the duration of 98000 chips after a trigger event.

IEC/IEEE-bus `:SOUR:IS95:TRIG:INH 16000`

TRIGGER OUT 1/2

Selection of signals for outputs TRIGOUT 1 and TRIGOUT 2 of connector PARDATA.
All the times indicated are valid for a chip rate of 1.2288 Mcps.

TRAFFIC FRAME	20-ms frame clock IEC `:SOUR:IS95:OUTP1 TFR`
SHORT SEQ ROLLOVER	80/3-ms clock IEC `:SOUR:IS95:OUTP1 SSR`
SUPER FRAME	80-ms clock IEC `:SOUR:IS95:OUTP1 SFR`
EVEN SECOND	2-s clock IEC `:SOUR:IS95:OUTP1 ESEC`
PCG	power control group rate IEC `:SOUR:IS95:OUTP1 GATE`

(TRIGGER...)

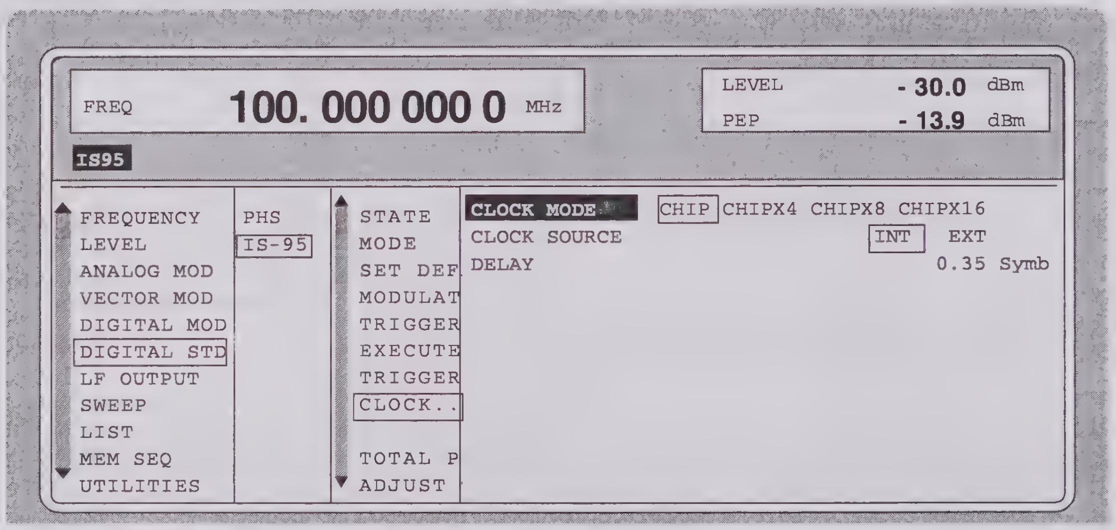
TRIGGER OUT 1/2 POL Selection of signal polarity at outputs TRIGOUT 1 and TRIGOUT 2 of the PARDATA connector.

IEC/IEEE-bus `:SOUR:IS95:OUTP1:POL NORM`

TRIGGER OUT 1/2 DELAY Setting the number of chips by which the selected trigger signal is delayed.

IEC/IEEE-bus `:SOUR:IS95:OUTP1:DEL -50`

CLOCK... Opens a window for selecting the clock source.
The CDMA chip clock in SMIQ corresponds to the symbol clock of the modulation. Therefore, the terms symbol clock and chip clock are synonymous.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 13.9 dBm

IS95

CLOCK MODE CHIP CHIPX4 CHIPX8 CHIPX16

CLOCK SOURCE INT EXT

DELAY 0.35 Symb

Fig. 2-77 Menu DIGITAL STD - IS-95 - CLOCK..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB42

(CLOCK...)

CLOCK MODE Selection of the type of external clock signal.

CHIP	Chip clock
CHIPXn	Four-, eight- or sixteen-fold chip clock (n=4, 8 or 16).

IEC/IEEE-bus `:SOUR:IS95:CLOC:MODE CHIP`

(CLOCK...)

CLOCK SOURCE

Selection of clock source.

INT	SMIQ uses internally generated clock signals.
EXT	An external chip clock is fed in at connector SYMBOL CLOCK. Multifolds of the chip clock are fed in at connector BIT CLOCK. The clock synthesizer on the modulation coder is synchronized to this clock. Parameter CHIP RATE has to be set with an accuracy of ± 1 %. The polarity, the trigger threshold and the input resistance of the SYMBOL CLOCK input can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus `:SOUR:IS95:CLOC:SOUR INT`

DELAY

Setting the delay of generated modulation signal to an external clock.

This can be used, for example, for synchronization with a second unit to achieve time synchroneity between the modulation signals of the two units.

The displayed setting resolution of 1/100 symbol is only attained for symbol-clock frequencies below 100 kHz.
The resolution is reduced with increasing frequency. At a chip rate of 1.2288 Mcps, the resolution equals the chip duration × 0.1.

IEC/IEEE-bus `:SOUR:IS95:CLOC:DEL 0.5`

TOTAL POWER

Display of the total power of all active code channels. The TOTAL POWER is calculated when the modulation is active (STATE = ON). It is the sum of the channel power of all active channels. If the value is not equal 0 dB then all active channel power were internally adjusted so that the total power equals 0 dB (the power relation between single code channels is not affected!) This is nessessary to keep the setted output power (LEVEL) constant. In addition to this average power (LEVEL) the peak envelope power (PEP) is also indicated in the header of the display. The value for PEP is calculated based on a worst case. The actual peak powers are mostly smaller.

IEC/IEEE-bus command `:SOUR:IS95:POW?`

ADJUST TOTAL POWER ▶

Changes the power of every code channel switched on. After this adjustment the total power is 0 dB. The power relation between single active code channels is not affected.

IEC/IEEE-bus command `:SOUR:IS95:POW:ADJ`

SAVE/RCL MAPPING...

Saves/calls up the set channel configuration.
This setting is only possible in the forward link mode.

For FWD_LINK_18, the following is saved for each channel number:

- selected WALSH CODE
- set POWER
- type of modulation data (DATA) and
- switch-on state.

For FWD_LINK_64, the following is saved for each channel number:

- set POWER
- modulation data (DATA) and
- switch-on state.

The channel configuration of the two forward-link modes is stored and loaded at the same time.

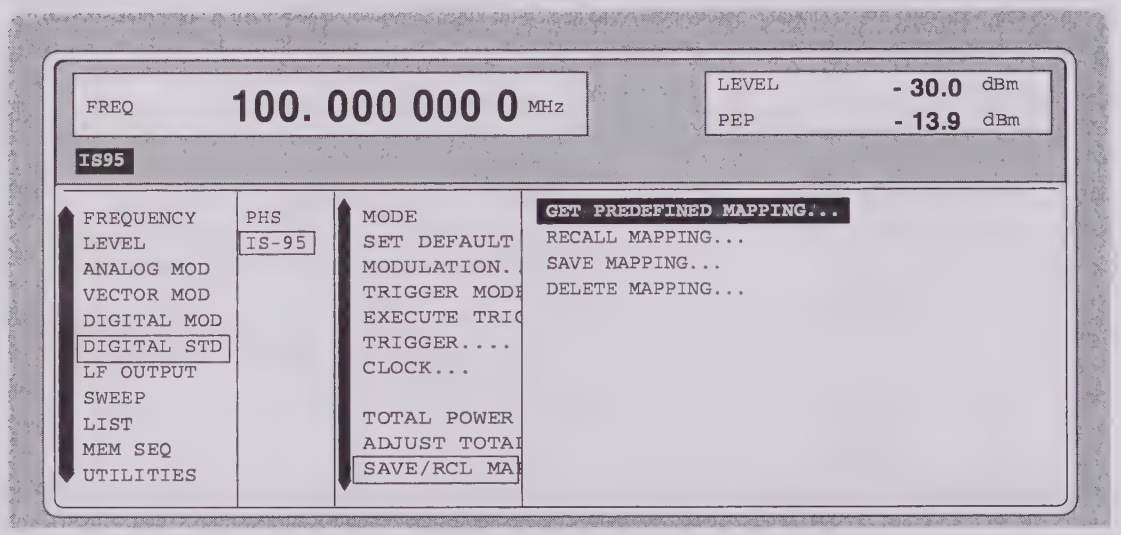


Fig. 2-78 Menu DIGITAL STD - IS-95 - SAVE/RCL MAPPING..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB42

(SAVE/RCL MAPPING...)

GET PREDEFINED MAPPING...

Loads a factory-set channel configuration.

PILOT	A pilot signal is generated only.
09CHAN	A signal with 9-code channels is generated according to the Base Station Test Model (IS95).
18CHAN	A signal with 18-code channels is generated.

IEEE-bus `:SOUR:IS95:MAPP:SEL:PRED "pilot"`

RECALL MAPPING...

Loads a stored channel configuration.

IEEE-bus `:SOUR:IS95:MAPP:LOAD "name"`

(SAVE/RCL MAPPING...)

SAVE MAPPING... Stores the channel configuration. For remote control, a name with 7 characters at max. can be used.

IIEEE-bus `:SOUR:IS95:MAPP:STOR "name"`

DELETE MAPPING... Deletes a stored channel configuration.

IEEE bus `:SOUR:IS95:MAPP:DEL "name"`

CHANNEL NO

Display of channel number.
This menu column is only displayed in the forward link mode.

WALSH CODE

Setting the Walsh code.
This menu column is only displayed in the forward link mode.

For FWD_LINK_18

- the Walsh code can be set individually for each channel.
  IEC/IEEE-bus command `:SOUR:IS95:CHAN1:WALS 32`

For FWD_LINK_64

- the Walsh code cannot be set. In this mode, the Walsh code corresponds to the channel number. All the 64 code channels are displayed.

POWER

Setting the power of channel.
This menu column is only displayed in the forward link mode.

POWER indicates the average power of the code channel relative to the power indicated in LEVEL display (code domain power).

For FWD_LINK_18

- the power of channels 0, 1, 2 is set individually.
- the other channels have the same power. The power for all the channels is set in channel 3.

For FWD_LINK_64

- the power of the pilot channel is set individually.
- the other channels have the same power. The power for all the channels is set in channel 1.

IEC/IEEE-bus command `:SOUR:IS95:CHAN1:POW -10 DB`

DATA

Setting the modulation data for the selected code channel.
This menu column is only displayed in the forward link mode.

The data rate for all forward link channels corresponds to the chip rate/64, ie 19200 bps at a chip rate of 1.2288 Mcps

0000	Continuous sequence of zeros IEC/IEEE-bus command `SOUR:IS95:CHAN1:DATA ZERO`
1111	Continuous sequence of ones IEC/IEEE-bus command `SOUR:IS95:CHAN1:DATA ONE`
1010	Alternating sequence of zeros and ones IEC/IEEE-bus command `SOUR:IS95:CHAN1:DATA ALT`
PRBS	Pseudo random data, different in every code channel IEC/IEEE-bus command `SOUR:IS95:CHAN1:DATA PRBS`

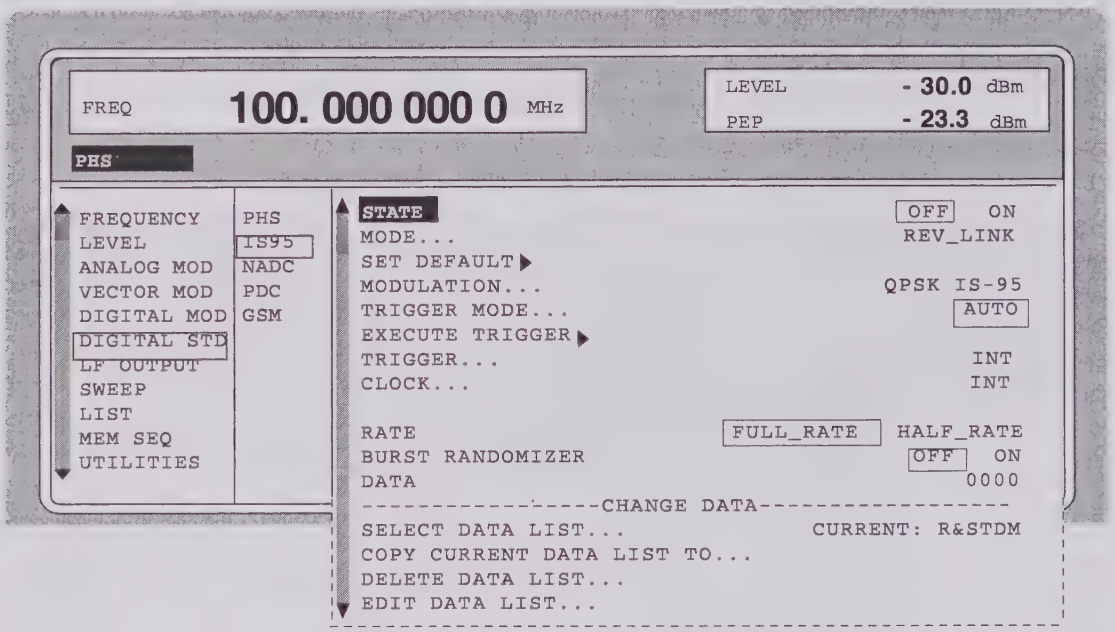
STATE

Switch on/off of assigned code channel.
This menu column is only displayed in the forward link mode.
IEC/IEEE-bus command `:SOUR:IS95:CHAN1:STAT ON`

2.12.5 Menu IS-95 CDMA Standard - Reverse Link Signal without Channel Coding

Menu DIGITAL STD - IS-95 provides access to settings for IS-95 CDMA signal generation. The following figure shows the menu for generating the reverse link signal (transmit signal of mobile station) without signal coding. The previous section showed the menu for generating the forward link signals as well as the parameters that are identical for both modes.

Menu selection: DIGITAL STD - IS-95- MODE - REV_LINK



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 23.3 dBm

STATE OFF ON

MODE... REV_LINK

MODULATION... QPSK IS-95

TRIGGER MODE... AUTO

TRIGGER... INT

CLOCK... INT

RATE FULL_RATE HALF_RATE

BURST RANDOMIZER OFF ON

DATA 0000

CURRENT: R&STDM

Fig. 2-79 Menu DIGITAL STD - IS-95 - MODE - REV_LINK

STATE to CLOCK	see section "Menu IS-95 CDMA-Standard- Forward Link Signal"
RATE	Selection of full-rate or half-rate transmission of modulation data. This selection is only possible in the reverse link mode. In the half-rate mode, only 8 of 16 power control groups of a frame are transmitted ("power gating"). IEC/IEEE-bus command `:SOUR:IS95:RATE HALF`
BURST RANDOMIZER	Switch on/off of burst randomizer. This selection is only possible during half-rate transmission in the reverse link mode. OFF Every second power control group is transmitted. ON A random algorithm determines which eight of the 16 power control groups of a frame will be transmitted. IEC/IEEE-bus command `:SOUR:IS95:RAND ON`

DATA

Selection of modulation data for the reverse link signal. The data rate corresponds to the chip rate x3/128, ie 28800 bps at 1.2288 Mcps.

0000	Continuous sequence of zeros IEC/IEEE-bus `:SOUR:IS95:DATA ZERO`
1111	Continuous sequence of ones IEC/IEEE-bus `:SOUR:IS95:DATA ONE`
1010	Alternating zeros and ones IEC/IEEE-bus `:SOUR:IS95:DATA ALT`
PRBS	PRBS data. IEC/IEEE-bus `:SOUR:IS95:DATA PRBS`
DLIST	Data from a programmable data list. IEC/IEEE-bus `:SOUR:IS95:DATA DLIS`

SELECT DATA LIST...

Opens a window for selecting a stored data list or for generating a new list (only with Reverse Link or Reverse Link Coded modes).

COPY CURRENT DATA LIST TO...

Stores the current data list under a different name (only with Reverse Link or Reverse Link Coded modes).

DELETE DATA LIST...

Deletes a data list (only with Reverse Link or Reverse Link Coded modes).

EDIT DATA LIST...

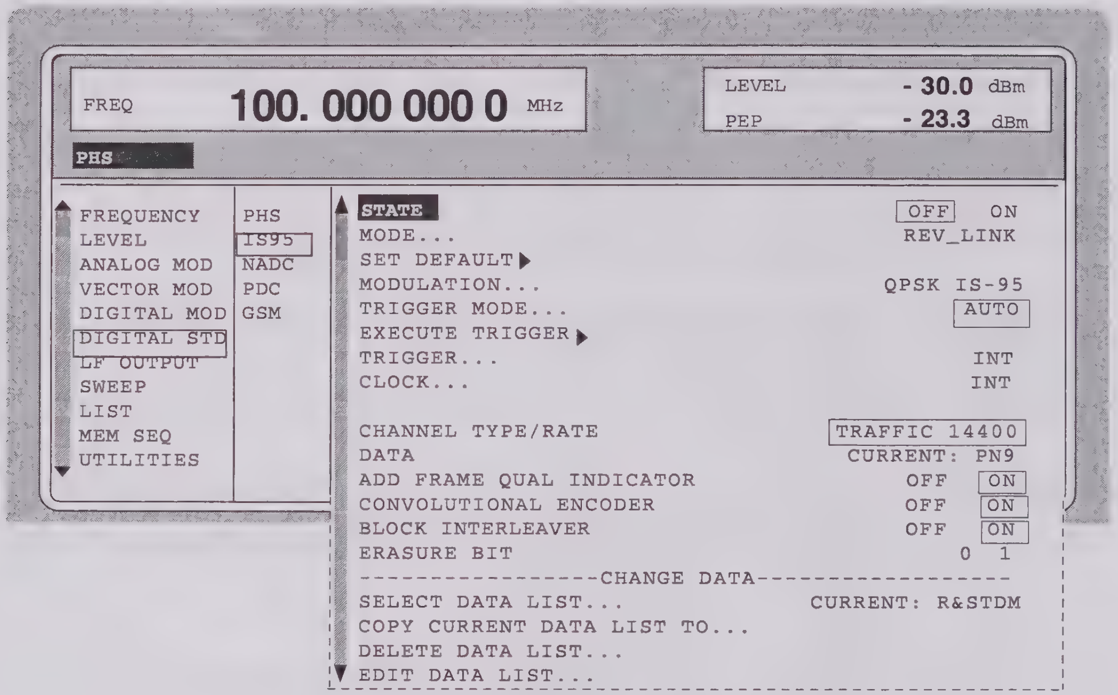
Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor). Only with Reverse Link or Reverse Link Coded modes.

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

2.12.6 Menu IS-95 CDMA Standard - Reverse Link Signal with Channel Coding

Menu DIGITAL STD - IS-95 provides access to settings for generating IS-95 CDMA signals. The following figure shows the menu for generating a reverse link signals with channel coding. The section on the menu for forward link signal generation shows the parameters that are identical for both modes.

Menu selection: DIGITAL STD - IS-95- MODE - REV_LINK_CODED



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 23.3 dBm

STATE OFF ON
MODE... REV_LINK
SET DEFAULT ▶
MODULATION... QPSK IS-95
TRIGGER MODE... AUTO
EXECUTE TRIGGER ▶
TRIGGER... INT
CLOCK... INT

CHANNEL TYPE/RATE TRAFFIC 14400
DATA CURRENT: PN9
ADD FRAME QUAL INDICATOR OFF ON
CONVOLUTIONAL ENCODER OFF ON
BLOCK INTERLEAVER OFF ON
ERASURE BIT 0 1
------------------CHANGE DATA------------------
SELECT DATA LIST... CURRENT: R&STDM
COPY CURRENT DATA LIST TO...
DELETE DATA LIST...
EDIT DATA LIST...

Fig. 2-80 Menu DIGITAL STD - IS-95 - MODE - REV_LINK_CODED

Parameter STATE to CLOCK... see section "Menu IS-95 CDMA Standard - Forward Link Signal".

CHANNEL TYPE/RATE

Selects the type of channel and the associated data rate. This selection is only possible in the reverse link mode. The selection also determines the structure of the channel coding and the number of data bits to be inserted into each frame.

TRAFFIC 14400	Traffic channel with 14400 bps. 267 bits are inserted into each frame
TRAFFIC 7200	Traffic channel with 7200 bps. 125 bits are inserted into each frame
TRAFFIC 3600	Traffic channel with 3600 bps. 55 bits are inserted into each frame
TRAFFIC 1800	Traffic channel with 1800 bps. 21 bits are inserted into each frame
ACCESS 4800	Access channel with 4800 bps. 88 bits are inserted into each frame
TRAFFIC 9600	Traffic channel with 9600 bps. 172 bits are inserted into each frame
TRAFFIC 4800	Traffic channel with 4800 bps. 80 bits are inserted into each frame
TRAFFIC 2400	Traffic channel with 2400 bps. 40 bits are inserted into each frame
TRAFFIC 1200	Traffic channel with 1200 bps. 16 bits are inserted into each frame
IEC/IEEE-bus	`:SOUR:IS95:RLC:CTYP TRAF7200` `:SOUR:IS95:RLC:CTYP ACC4800`

DATA SOURCE

Selects the modulation data for the reverse link signal with channel coding. The data are continuously inserted into the data field of the corresponding frame.

PN..	PRBS data to CCITT with period length between 2^9-1 and 2^{23}-1. IEC/IEEE-bus command `:SOUR:IS95:RLC:DATA PN1`
DLIST	Data from a previously programmed and stored data list. IEC/IEEE-bus command `:SOUR:IS95:RLC:DATA DLISt`

ADD FRAME QUAL INDICATOR

Switches the frame quality indicator (CRC calculation) on or off. With OFF selected, only zeros are sent instead of CRC bits.

IEC/IEEE-bus command `:SOUR:IS95:RLC:FQIN ON`

CONVOLUTIONAL ENCODER

Switches the convolutional encoder on or off. With OFF selected, the data rate is attained by repeating the symbol.

IEC/IEEE-bus command `:SOUR:IS95:RLC:CENC ON`

BLOCK INTERLEAVER

Switches the interleaver function on or off.

IEC/IEEE-bus command `:SOUR:IS95:RLC:BINT ON`

ERASURE BIT

Selects 1 or 0 for the erasure bit.

IEC/IEEE-bus command `:SOUR:IS95:RLC:EBIT 0`

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see section "Menu IS-95 CDMA Standard - Forward Link Signal"

2.13 Digital Standard W-CDMA

With the options Modulation Coder (SMIQB20), Data Generator (SMIQB11) and option Digital Standard W-CDMA (SMIQB43) provided, W-CDMA signals can be generated according to Japanese specifications, especially according to ARIB standard[1].

SMIQ can simulate both the transmit signal of a base station (Downlink), and the transmit signal of a mobile station (Uplink) with up to 15 code channels.

Different physical channel types such as Perch, Common Control or Dedicated Physical Channel can be selected. For this purpose, SMIQ generates modulation data with the frame structure specified in the standard (framed data). Data fields with pilot symbols, TPC symbols (Traffic Power Control) or LMS symbols (Long Code Mask) are automatically generated. Freely programmable data lists or pseudo-random bit sequences (PRBS) can be used for the modulation symbols in the DATA fields. These modulation data are not subjected to any channel coding (convolution coding, interleaving). The user can, however, store channel-coded modulation data in a data list to generate a logic channel, eg a Dedicated Traffic Channel.

The following figure shows the schematic of forward link signal generation.

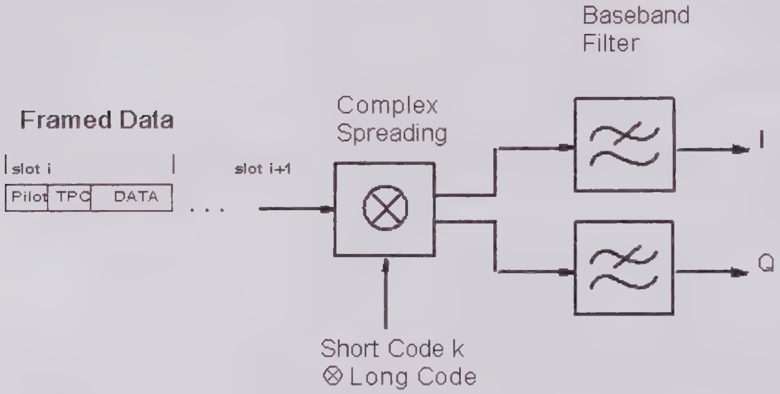


Fig. 2-81 Downlink DPCH signal generation for a code channel

The Perch Channel, DPCH (Dedicated Physical Channel) and CCPCH (Common Control Physical Channel) are available as channel types in the downlink. The data rate for modulation data (framed data) of the DPCH can be selected (32, 64, to 1024 ksymbol/s). The type of modulation is QPSK, but O-QPSK can also be set. A root cosine filter with roll-off factor 0.22 is preset for baseband filtering. Other filters can also be set (MODULATION FILTER). The chip rate is preset to 4.096 Mcps but can be modified within wide limits.

Two modes (LINK DIRECTION/MULTIPLEX) are available to generate an uplink signal. A mobile station transmitter of the Japanese W-CDMA experimental system is simulated in the UP mode. The frame structure of data corresponds to that of the downlink. DPCH and CCPCH are available as channel types.

---

[1] Association of Radio Industries and Businesses (ARIB), Specifications of Air-Interface for a 3 G Mobile System

A mobile station transmitter in line with the ARIB standard is simulated in the UP_IQ_MULT mode. Separate channel types and data sources for I and Q are available in the multiplex mode.

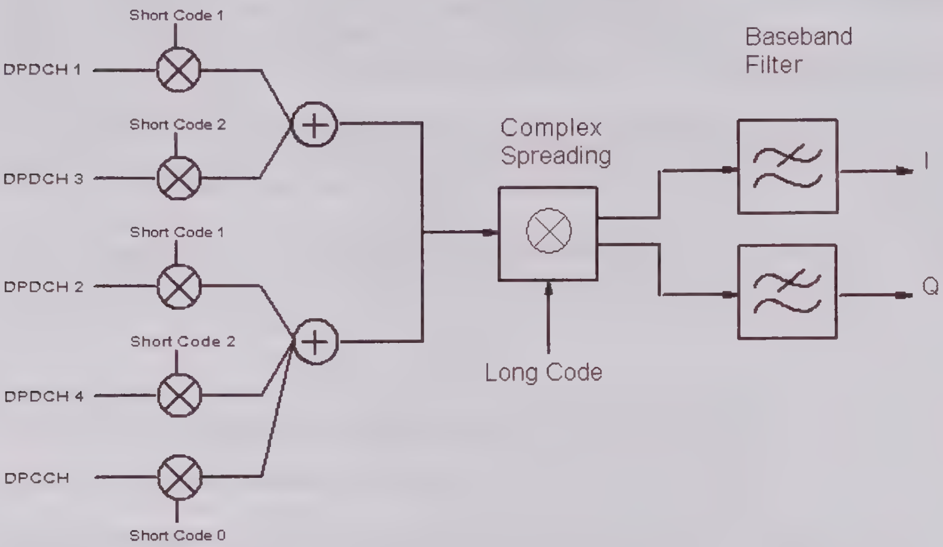


Fig. 2-82 Uplink signal generation with IQ multiplex and several code channels

According to ARIB, DPDCH (Dedicated Physical Data Channel) and DCPCH (Dedicated Control Physical Channel) are available as channel types in the uplink. The data rate for modulation data (framed data) of the DPDCH can be selected (16, 32, 64, to 1024 ksymbol/s).

The modulation data are not calculated in real time in SMIQ. On the user request, a W-CDMA chip sequence is calculated (STATE = ON) and then stored in the data memory of the data generator (option SMIQ B11). The sequence length is settable (SEQUENCE LENGTH [FRAMES]), the maximum possible length depends on the memory capacity of the data generator.

A special multicode mode is available (MULTICODE) for LINK DIRECTION/MULTIPLEX DOWN and UP modes. The data fields Pilot and TPC have the same settings and are spread with the same spreading codes of the MASTER CHANNEL.

2.13.1 Sync and Trigger Signals

A chip sequence is calculated for the generation of W-CDMA signals and stored in the memory of the data generator (option SMIQB11). This chip sequence can be run repetitively (TRIGGER MODE AUTO).
Trigger signals can be used for synchronized measurements on receivers (TRIGGER MODE RETRIG, ARMED_AUTO or ARMED_RETRIG).

A trigger signal can be fed via the TRIGIN input at connector PAR DATA of SMIQ. The chip sequence either starts immediately after the active slope of the trigger signal or after a settable number of chips (EXT TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a settable number of chips (EXT RETRIGGER INHIBIT).

A trigger event can be executed manually or via the IEC/IEEE bus using EXECUTE TRIGGER.
When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ generates the following sync signals:

- a 0.625 ms slot clock
- a 10 ms radio frame clock
- a marker signal for identifying the periodic repetition of the generated chip sequence

SMIQ can output two of the three signals via pins TRIGOUT 1 and 2 of connector PAR DATA.

A clock synthesizer on the modulation coder generates the chip clock in the SMIQ. All the clock signals are synchronized to the 10-MHz reference of the SMIQ. The chip clock is available at connector SYMBOL CLOCK. If required, the clock synthesizer in the SMIQ can be synchronized to an external chip clock which is fed in at connector SYMBOL CLOCK.

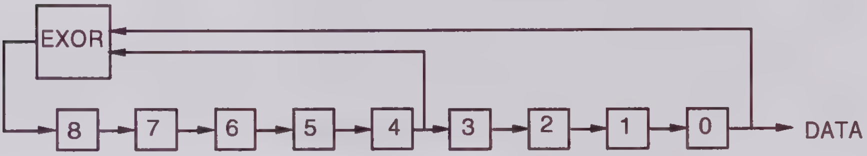
To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct chip rate at SMIQ (MODULATION - CHIPRATE VARIATION). Then switch CLOCK SOURCE from INT to EXT.

Note: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.13.2 PN Generators as Internal Data Source

Different PN (Pseudo Noise) generators can be selected as data source for DATA fields. These PN generators provide pseudo random bit sequences of different lengths or periods which is why they are also called PRBS generators (Pseudo Random Binary Sequence).

The data sequences are so-called sequences of maximum lengths that are generated by means of feedback shift registers.
The following schematic shows the 9 bit generator with feedback to registers 4 and 0 (output).



The pseudo random sequence of a PRBS generator is determined by the number of registers and the feedback. The following table describes all available PRBS generators:

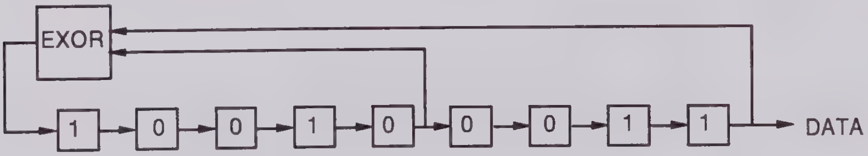
Table 2-17 PN generators for W-CDMA

PRBS generator	Length in bits	Feedback to	Start value (*)
9 bits	$2^9 - 1 = 511$	Register 4, 0	Channel 0: 0000 0100 1 Channel 1: 1000 0100 1 Channel 2: 0100 0100 1 Channel 3: 1100 0100 1 ... Channel 15: 1111 0100 1
11 bits	$2^{11} - 1 = 2047$	Register 2, 0	Channel 0: 0000 0100 100 ... Channel 15: 1111 0100 100
15 bits	$2^{15} - 1 = 32767$	Register 1, 0	Channel 0: 0000 0100 1000 000 ... Channel 15: 1111 0100 1000 000
16 bits	$2^{16} - 1 = 65535$	Register 5, 3, 2, 0	Channel 0: 0000 0100 1000 0000 ... Channel 15: 1111 0100 1000 0000

*) the 5th start value bit of channels in Q phase is 1 (for example: channel 3: 1100 1100 1...)

PN generators PN9,11 and PN15 are designed according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generator PN15.

Example: PN9 generator in channel 3 with start value 110001001 (binary)



The resulting output sequence is `110001001100010001000` etc.

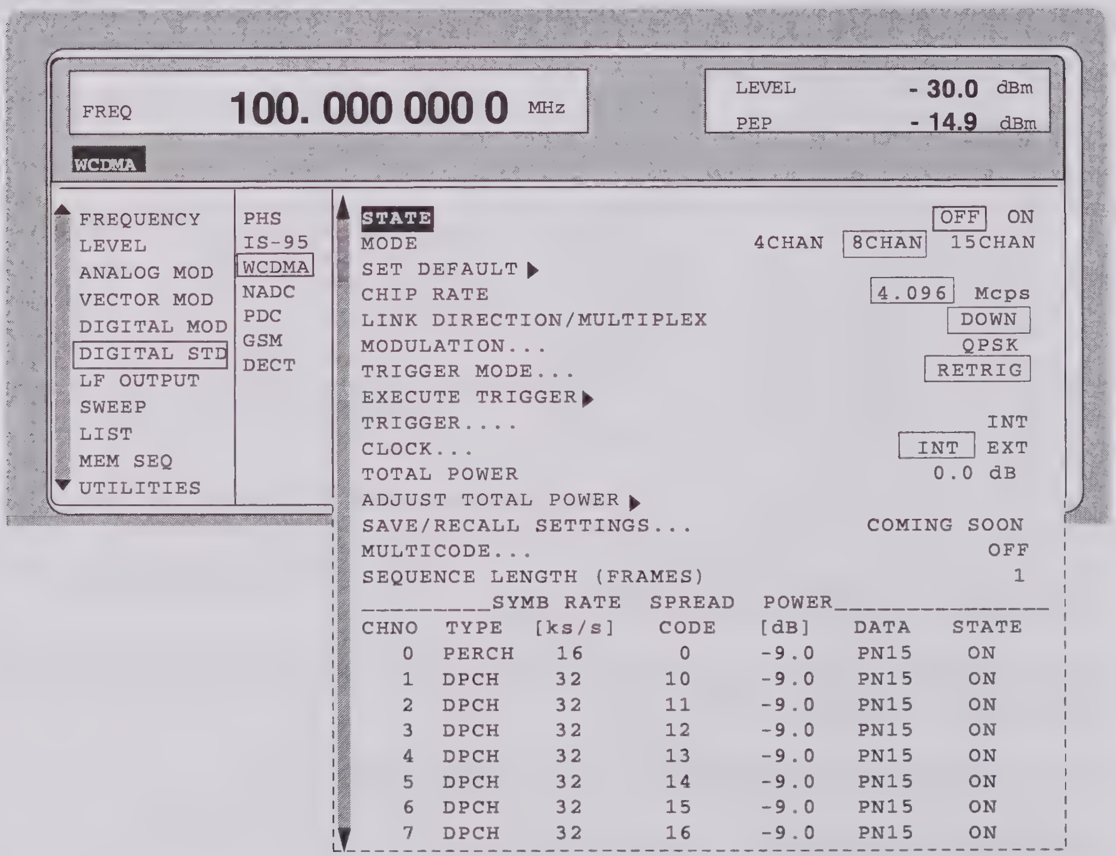
2.13.3 Lists as an Internal Data Source

A freely programmable memory can be used as a data source for DATA or TPC fields. The data are managed in lists. A list editor enables the data lists (DATA LIST) to be selected, copied, modified and erased. The list editor can be accessed via the menu DIGITAL MOD SOURCE...

2.13.4 Menu W-CDMA Standard - Downlink and Uplink Signals without IQ Multiplex

Menu DIGITAL STD - W-CDMA provides access to settings for W-CDMA signal generation.
The figure below shows an example of the menu for generating the downlink signal (transmit signal of the base station) in the 8CHAN mode. The menus for generating uplink signals without IQ multiplex have nearly the same structure. A menu for generating uplink signals with IQ multiplex is shown in the next section. Parameters that are identical for all modes are explained in this section.

Menu selection: DIGITAL STD - WCDMA - MODE - 8CHAN, -LINK DIRECTION/MULTIPLEX DOWN



```
FREQ      100. 000 000 0  MHz              LEVEL    - 30.0  dBm
                                           PEP      - 14.9  dBm

STATE                                                OFF   ON
MODE                                    4CHAN  8CHAN  15CHAN
SET DEFAULT ▶
CHIP RATE                                        4.096  Mcps
LINK DIRECTION/MULTIPLEX                                DOWN
MODULATION...                                           QPSK
TRIGGER MODE...                                       RETRIG
EXECUTE TRIGGER▶
TRIGGER....                                              INT
CLOCK...                                           INT   EXT
TOTAL POWER                                           0.0 dB
ADJUST TOTAL POWER ▶
SAVE/RECALL SETTINGS...                          COMING SOON
MULTICODE...                                             OFF
SEQUENCE LENGTH (FRAMES)                                   1
__________SYMB RATE   SPREAD   POWER________________
CHNO   TYPE   [ks/s]    CODE    [dB]     DATA     STATE
   0   PERCH    16        0     -9.0     PN15      ON
   1   DPCH     32       10     -9.0     PN15      ON
   2   DPCH     32       11     -9.0     PN15      ON
   3   DPCH     32       12     -9.0     PN15      ON
   4   DPCH     32       13     -9.0     PN15      ON
   5   DPCH     32       14     -9.0     PN15      ON
   6   DPCH     32       15     -9.0     PN15      ON
   7   DPCH     32       16     -9.0     PN15      ON
```

Fig. 2-83 Menu DIGITAL STD - WCDMA - MODE - 8CHAN, LINK DIRECTION/MULTIPLEX - DOWN, equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

STATE

Switch on/off of modulation Digital Standard W-CDMA. Vector modulation and digital modulation will be switched off automatically.

STATE = ON starts the calculation of a chip sequence based on the current settings. The lenght of the chip sequence and therefore the duration of calculation are determined by parameter SEQUENCE LENGTH.

IEC/IEEE-bus command `:SOUR:WCDM:STAT ON`

MODE...

Opens a window for selecting from the different modes to determine the number of code channels.
The physical channel type (TYPE), the symbol rate, some spreading parameters (SPREAD CODE) and the source for modulation data (DATA) can be separately defined for each channel. Each channel can be switched on or off (STATE).

4CHAN

Activates the generation of a signal with up to 4 code channels (channel No. 0 to 3).
The relative power (POWER) of the channels can be freely determined in range -30 dB to 0 dB.

IEC/IEEE-bus `:SOUR:WCDM:MODE CHAN4`

8CHAN

Activates the generation of a signal with up to 8 code channels (channel No. 0 to 7).
The relative power (POWER) of channel 0 can be freely determined in range -30 dB to 0 dB. The power setting of channel 1 also determines the power setting of channels 2 to 7. This means that channels 1 to 7 all have the same power provided when the channels are switched on.

IEC/IEEE-bus `:SOUR:WCDM:MODE CHAN8`

15CHAN

Activates the generation of a signal with up to 15 code channels (channel No. 0 to 14).
The relative power of channels cannot be freely defined since all activated code channels have the same power. The relative power is displayed (POWER).

IEC/IEEE-bus `:SOUR:WCDM:MODE CHAN15`

SET DEFAULT ▶

Provides the default setting for W-CDMA.

For LINK DIRECTION/MULTIPLEX DOWN

- in mode 8, channel 0 is a Perch channel, it is switched on and its symbol rate is 16 ksymbol/s
- all other channels are also switched on (STATE ON), channel type (TYPE) is DPCH, symbol rate is 32 ksymbol/s
- the channels have the same relative power (POWER)
- the data are pseudo random (PN15), except for Perch channel, a data offset of three times the channel number (3 • CHNO) is set.

For LINK DIRECTION/MULTIPLEX UP

- only channel 0 is switched on, channel type is DPCH, symbol rate is 32 ksymbol/s
- the data are pseudo random (PN15), no data offset is set.

For LINK DIRECTION/MULTIPLEX UP_IQ_MULT

- all channels are switched on except I-channel 0 in mode 8
- Q-channel 0 is configured as DPCCH, all the other channels are configured as DPDCH with a symbol rate of 16 ksymbol/s
- all channels have the same relative power (POWER)
- the data are pseudo random (PN15), no data offset is set.

IEC/IEEE-bus `:SOUR:WCDM:PRES`

CHIP RATE

Selection between 4.096 Mcps and 8.192 Mcps. Selecting 8.192 Mcps depends on the hardware configuration of the unit and is not offered yet. Selecting CHIP RATE has an effect on the generation of spreading codes and thus on the calculated chip sequence.

IEC/IEEE-bus `:SOUR: WCDM:CRAT R4M`

LINK DIRECTION/ MULTIPLEX

Opens a window for selecting the type of transmit signal from the different modes.

DOWN

Activates the generation of a downlink signal. In this mode, the transmit signal of a base station can be generated in line with the Japanese ARIB standard or according to NTTDoCoMo specifications for an experimental system.

IEC/IEEE-bus `:SOUR:WCDM:LINK DOWN`

UP

Activates the generation of an uplink signal. In this mode, the transmit signal of a mobile station can be generated in line with the NTTDoCoMo specifications for an experimental system.

IEC/IEEE-bus `:SOUR:WCDM:LINK UP`

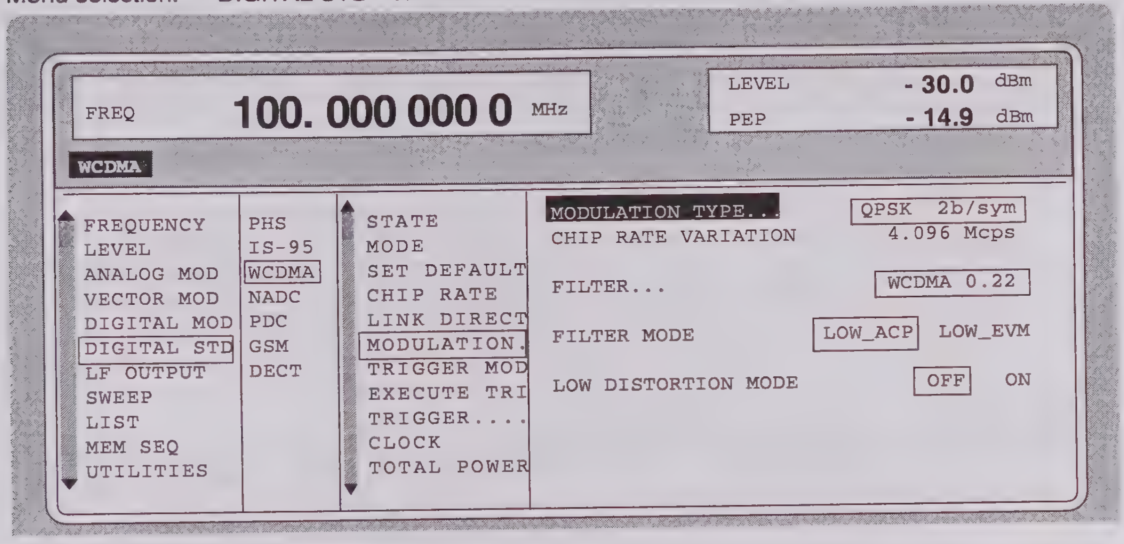
UP_IQ_MULT

Activates the generation of an uplink signal with a multiplex mode for the I and Q channel. Separate channel types and data sources are available for I and Q. In this mode, the transmit signal of a mobile station can be generated in line with the Japanese ARIB standard.

IEC/IEEE-bus `:SOUR:WCDMA:LINK UPM`

MODULATION... Opens a window for setting the modulation parameters.

Menu selection: DIGITAL STD - WCDMA - MODULATION...



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 14.9 dBm

MODULATION TYPE... QPSK 2b/sym

CHIP RATE VARIATION 4.096 Mcps

FILTER... WCDMA 0.22

FILTER MODE LOW_ACP LOW_EVM

LOW DISTORTION MODE OFF ON

Fig. 2-84 Menu DIGITAL STD - WCDMA - MODULATION..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

(MODULATION...)

MODULATION TYPE Selection between the types of modulation QPSK and offset QPSK.

IEC/IEEE-bus `:SOUR:WCDM:FORM QPSK`

CHIP RATE VARIATION Setting value for the chip clock frequency. The value for CHIPRATE from the main menu is preset. CHIP RATE VARIATION modifies the output clock and the modulation bandwidth as well as the output synchronization signals. It has no effect on the calculated chip sequence.

IEC/IEEE-bus `:SOUR:WCDM:CRAT:VAR 4096001`

FILTER... Opens a window for selecting the baseband filter. Selection can be made between a filter optimized for W-CDMA and the standard Nyquist filters COS and SQRCOS. The optimized root cosine filter WCDMA 0.22 is preset. Its roll-off factor is fixed to 0.22.

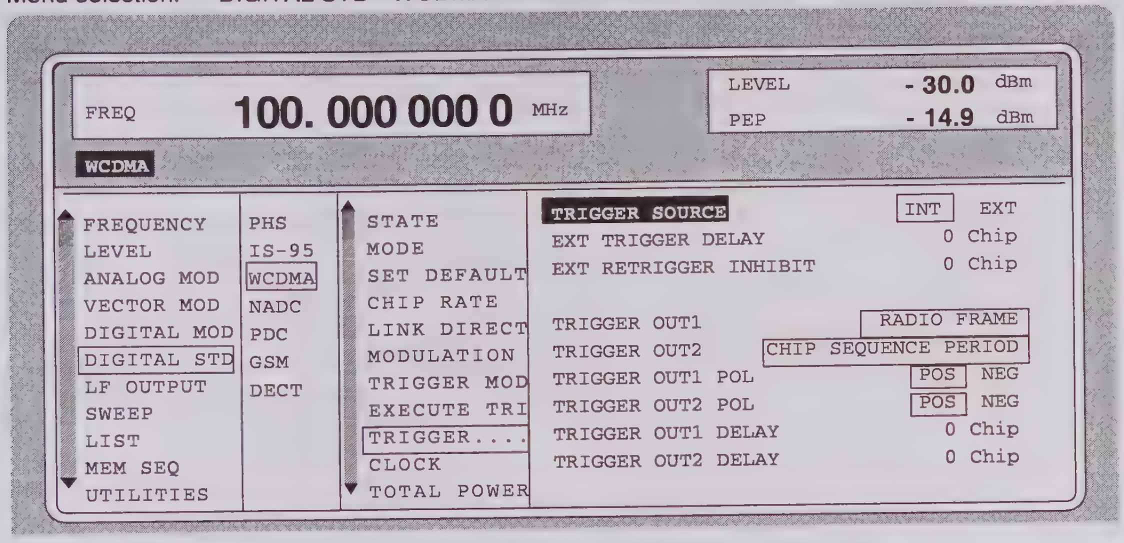
IEC/IEEE-bus `:SOUR:WCDM:FILT:TYPE WCDM`

ROLL OFF FACTOR Setting value of roll-off factor.
The setting is only possible provided that a COS or SQRCOS filter is selected under FILTER.

IEC/IEEE-bus `:SOUR:WCDM:FILT:PAR 0.22`

(MODULATION...)	**FILTER MODE**	Selection of filter mode. LOW_ACP Filter for minimum Adjacent Channel Power. IEC/IEEE-bus command `:SOUR:WCDM:FILT:MODE LACP` LOW_EVM Filter for minimum vector error. IEC/IEEE-bus command `:SOUR:WCDM:FILT:MODE LEVM`
	LOW DISTORTION MODE	Switch on/off of low-distortion mode. After switch-on, the level of the IQ baseband signals is reduced by 3 dB. In some cases, this might reduce undesired intermodulation products. OFF is normally the more favourable setting. IEC/IEEE-bus `:SOUR:WCDM:LDIS:STAT OFF`
TRIGGER MODE	Opens a window for selecting the W-CDMA sequence.	
	AUTO	The calculated W-CDMA chip sequence is cyclically repeated. IEC/IEEE-bus command `:SOUR:WCDM:SEQ AUTO`
	RETRIG	The W-CDMA chip sequence is continuously repeated. A trigger event causes a restart from frame 1. IEC/IEEE-bus command `:SOUR:WCDM:SEQ RETR`
	ARMED_AUTO	The W-CDMA chip sequence cannot be started from frame 1 until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus command `:SOUR:WCDM:SEQ AAUT`
	ARMED_RETRIG	The W-CDMA chip sequence cannot be started from frame 1 until a trigger event has occurred. each new trigger event causes a restart. IEC/IEEE-bus command `:SOUR:WCDM:SEQ ARET`
EXECUTE TRIGGER ▶	Executes a trigger event to start the W-CDMA chip sequence. IEC/IEEE-bus command `:TRIG:DM:IMM`	
TRIGGER...	Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.	

Menu selection: DIGITAL STD - WCDMA - TRIGGER...



FREQ 100.000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 14.9 dBm

TRIGGER SOURCE [✓ INT] EXT

EXT TRIGGER DELAY 0 Chip

EXT RETRIGGER INHIBIT 0 Chip

TRIGGER OUT1 RADIO FRAME

TRIGGER OUT2 CHIP SEQUENCE PERIOD

TRIGGER OUT1 POL [✓ POS] NEG

TRIGGER OUT2 POL [✓ POS] NEG

TRIGGER OUT1 DELAY 0 Chip

TRIGGER OUT2 DELAY 0 Chip

Fig. 2-85 Menu DIGITAL STD - WCDMA - TRIGGER..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

TRIGGER...

TRIGGER SOURCE

Selection of trigger source.

EXT — The W-CDMA chip sequence is started from frame 1 by means of the active slope of an external trigger signal.
The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.

INT — A trigger event is manually executed by EXECUTE TRIGGER.

IEC/IEEE-bus `:SOUR:WCDM:TRIG:SOUR EXT`

EXT TRIGGER DELAY

Setting the number of chips by which an external trigger signal is delayed before it starts the W-CDMA chip sequence.
This is used for setting the time synchroneity between the DUT and other units.

IEC/IEEE-bus `:SOUR:WCDM:TRIG:DEL 3`

EXT RETRIGGER INHIBIT

Setting the number of chips for which a restart is inhibited after a trigger event.
With TRIGGER MODE RETRIG selected, each new trigger signal restarts the W-CDMA chip sequence. This restart can be inhibited for the entered number of chips.

Example:
The entry of 82000 chips, for example, causes new trigger signals to be ignored for the duration of 82000 chips after a trigger event.

IEC/IEEE-bus `:SOUR:WCDM:TRIG:INH 82000`

(TRIGGER...)

TRIGGER OUT 1/2

Selection of signals for outputs TRIGOUT 1 and TRIGOUT 2 of connector PARDATA.
The time specifications are valid only if the frequency of the internal clock generation is not modified with the parameter CHIP RATE VARIATION.

SLOT	0.625 ms time slot clock IEC/IEEE-bus: `:SOUR:WCDM:TRIG:OUTP1 SLOT`
RADIO FRAME	10 ms frame clock IEC/IEEE-bus: `:SOUR:WCDM:TRIG:OUTP1 RFR`
CHIP SEQUENCE PERIOD	Marker signal for identifying the periodic repetition of the generated chip sequence IEC/IEEE-bus: `:SOUR:WCDM:TRIG:OUTP1 CSP`

TRIGGER OUT 1/2 POL

Selection of signal polarity at outputs TRIGOUT 1 and TRIGOUT 2 of the PARDATA connector.

IEC/IEEE-bus `:SOUR:WCDM:OUTP2:POL POS`

TRIGGER OUT 1/2 DELAY

Setting the number of chips by which the selected trigger signal is delayed.

IEC/IEEE-bus `:SOUR:WCDM:OUTP2:DEL 0`

CLOCK...

Enables the selection of the clock source of the chip clock.

INT	SMIQ uses internally generated clock signals.
EXT	A chip clock should externally be applied to connector SYMBOL CLOCK. Parameter CHIP RATE should be correctly set with a precision of ± 1 %. The polarity, the trigger threshold and the input resistance of the SYMBOL CLOCK input can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus `:SOUR:WCDM:CLOC:SOUR INT`

TOTAL POWER

Display of the total power of all active code channels. The TOTAL POWER is calculated when the modulation is active (STATE = ON). It is the sum of the channel power of all active channels. If the value is not equal 0 dB then all active channel power were internally adjusted so that the total power equals 0 dB (the power relation between single code channels is not affected!) This is nessessary to keep the setted output power (LEVEL) constant. In addition to this average power (LEVEL) the peak envelope power (PEP) is also indicated in the header of the display. The value for PEP is calculated based on a worst case. The actual peak powers are mostly smaller.

IEC/IEEE-bus command `:SOUR:WCDM:POW?`

ADJUST TOTAL POWER ▶

Changes the power values of all activated code channels. After this adjustment the total power is 0 dB. The power relation between single active code channels is not affected.

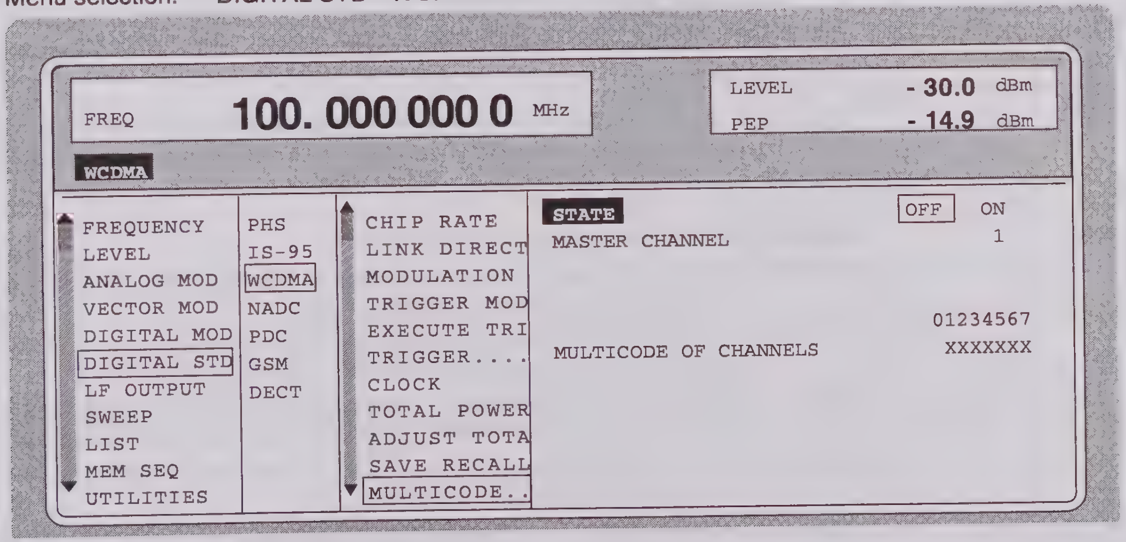
IEC/IEEE-bus command `:SOUR:WCDM:POW:ADJ`

SAVE/RECALL SETTING

Saves/calls up the set channel configuration. The configuration consists of all W-CDMA parameters, except the parameters from the TRIGGER menus, the CLOCK menu and the MODULATION menu.

GET PREDEFINED SETTING...	COMING SOON
RECALL SETTING...	COMING SOON
SAVE SETTING...	COMING SOON
DELETE SETTING...	COMING SOON

Menu selection: DIGITAL STD - WCDMA - MULTICODE...



STATE OFF ON

MASTER CHANNEL 1

MULTICODE OF CHANNELS 01234567 XXXXXXX

Fig. 2-86 Menu DIGITAL STD - WCDMA - MULTICODE..., equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

MULTICODE...

Opens a window for selecting multicode settings. The multicode mode cannot be activated in the LINK DIRECTION/MULTIPLEX UP-IQ_MULT mode. In the multicode mode, the data fields Pilot and TPC have the same settings and are spread with the same spread codes of the MASTER CHANNEL for all selected code channels.

STATE Switch on/off the multicode mode.

IEC/IEEE-bus `:SOUR:WCDM:MULT:STAT ON`

MASTER CHANNEL Selection of the master channel. This channel defines spread code and contents for data fields Pilot and TPC in all multicode channels. The selection also causes that parameters LONG CODE INIT, LONG CODE OFFSET, SYMBOL RATE and DATA OFFSET of the selected multicode channels are set to the same values as the master channel.

IEC/IEEE-bus `:SOUR:WCDM:MULT:MAST 1`

MULTICODE OF CHANNELS Selection of the channels for multicode transmission. The selected channels are marked with an X.

IEC/IEEE-bus `:SOUR:WCDM:MULT:CHAN #H1ED3`

SEQUENCE LENGTH [FRAMES]

Defines the length of the calculated chip sequence in number of frames.

IEC/IEEE-bus command `:SOUR:WCDM:SLEN 4`

CHNO

Column title for the display of the number of the channel for which the settings of the corresponding line are valid. The other columns can be selected with "=>" and "<=".

TYPE

Opens a window for selecting the channel type.

PERCH	Perch 1-channel with Pilot, DATA and LMS data field. Selection is possible with LINK DIRECTION - DOWN.
CCPCH	Common Control Physical Channel with Pilot and DATA field. Selection is possible with LINK DIRECTION - DOWN and UP.
DPCH	Dedicated Control Physical Channel with Pilot, TPC and DATA field. Selection is possible with LINK DIRECTION - DOWN and UP.
ALLD	All data channel type only with DATA field. Selection is possible with LINK DIRECTION - DOWN and UP.

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:DPCH`

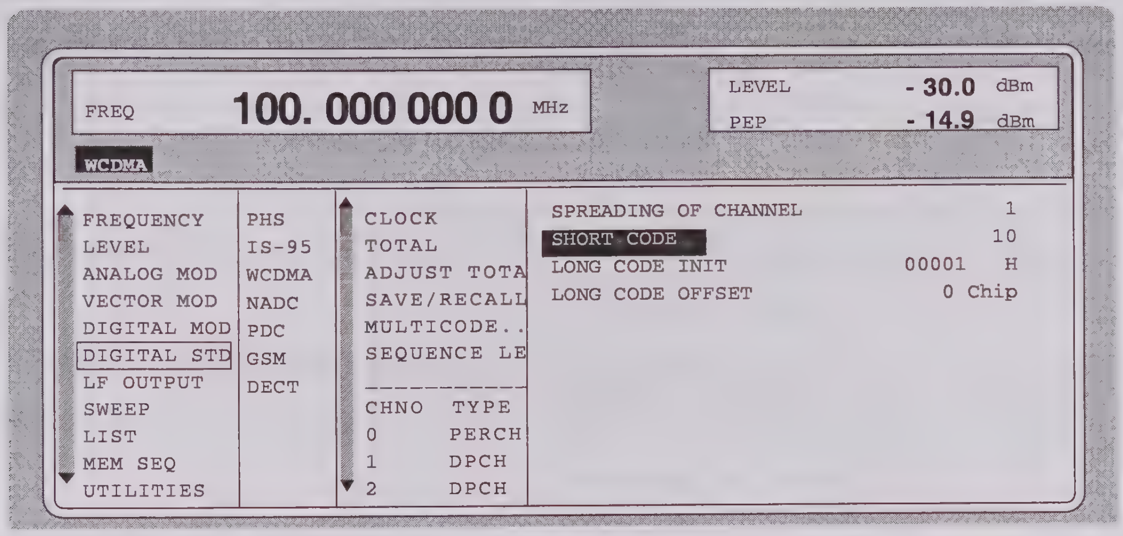
SYMBOL RATE

Opens a window for selecting the symbol rate. The admissible selection depends on the channel type selected (TYPE). The possible values are represented in the following table:

TYPE	SYMBOL RATE kS/s
PERCH	16
CCPCH	64
DPCH	32, 64, 128, 256, 512, 1024
DPDCH	16, 32, 64, 128, 256, 512, 1024
DPCCH	16
ALLD	16, 32, 64, 128, 256, 512, 1024

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:SRAT D64`

Menu selection: DIGITAL STD - WCDMA - SPREAD CODE



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 14.9 dBm

SPREADING OF CHANNEL 1

SHORT CODE 10

LONG CODE INIT 00001 H

LONG CODE OFFSET 0 Chip

Fig. 2-87 Menu DIGITAL STD - WCDMA - SPREAD CODE; equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

SPREAD CODE Opens a window for the spread code settings. The first line of the window indicates the code channel for which the settings are done (SPREADING OF CHANNEL NO).

SHORT CODE Entry value for the short code index. The upper limit depends on parameters CHIP RATE, SYMBOL RATE as well as on the channel type.

IEC/IEEE `:SOUR:WCDM:CHAN4:SCOD 12`

LONG CODE INIT Entry value for initializing the long code generator in hexadecimal notation.

IEC/IEEE `:SOUR: WCDM:CHAN4:LCOD #HFFF`

LONG CODE OFFSET Entry value for a time shift of the long code with respect to the data symbols in units of chip duration.

IEC/IEEE `:SOUR:WCDM:CHAN4:LCOD:OFFS 1`

LMS SHORT CODE Entry value for the short code index used for spreading the long code mask symbols (LMS) of the Perch channel.

IEC/IEEE `:SOUR:WCDM:CHAN4:SCOD:LMS #HFF`

POWER Input value for channel power.

POWER indicates the average power of the code channel relative to the power indicated in LEVEL display (code domain power).

For MODE - 4CHAN

- the power of channels 0, 1, 2 and 3 is set separately.

For MODE - 8CHAN

- the power of channel 0 is set separately.
- the other channels have the same power. The power for all the channels is set, for instant, in channel 1.

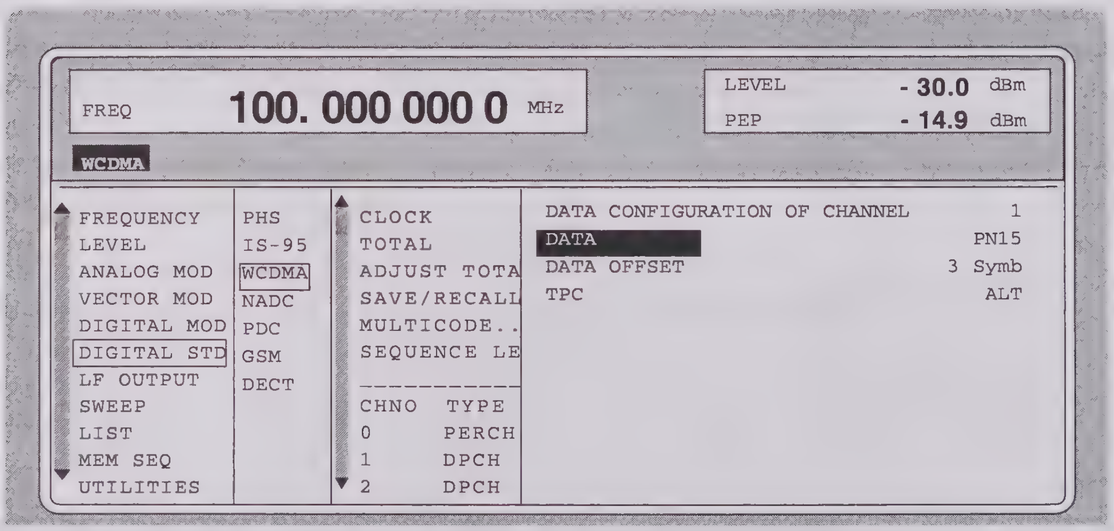
For MODE - 15CHAN

- Since all channels have the same power, they cannot be set. POWER is only a display parameter in this case.

When this value is modified, the value of TOTAL POWER is automatically adapted.

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:POW -3`

Menu selection: DIGITAL STD - WCDMA - DATA



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 14.9 dBm

DATA CONFIGURATION OF CHANNEL 1

DATA PN15

DATA OFFSET 3 Symb

TPC ALT

Fig. 2-88 Menu DIGITAL STD - WCDMA - DATA; equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

DATA... Opens a window for selecting data sources and setting a data offset. The first line of the window indicates the code channel for which the settings are done (DATA CONFIGURATION OF CHANNEL NO).

(DATA...)

DATA

Selection of the data source for the DATA field of the selected channel type. The data from the selected data source are permanently continued from slot to slot in the data field.

PN..	PRBS data to CCITT with period lengths between 29-1 and 216-1.
DLIST	Data from a list previously programmed and stored. Programming is performed in the menu DIGITAL MOD - SOURCE - EDIT DATA LIST

IEC/IEEE-bus `:SOUR:WCDM:CHAN4:DATA PN9`

DATA OFFSET

Entry value for a data offset in units of symbol duration. The admissible range is as large as the length of a radio frame. The entry of a data offset shifts in time the modulation data with respect to the spread code.

IEC/IEEE-bus `:SOUR:WCDM:CHAN4:DATA:OFFS 3`

TPC

Selection of the data source for the TPC field in channel types DPCH and DPCCh.

0	0 data are continuously generated
1	1 data are continuously generated
ALT	The TPC field is alternately assigned with 1 or 0 from slot to slot. (The first slot contains 1 data).
DLIST	Data from a list previously programmed and stored. Programming is performed in the menu DIGITAL MOD - SOURCE - EDIT DATA LIST

IEC/IEEE-bus `:SOUR:WCDM:CHAN4:TPC ZERO`

STATE

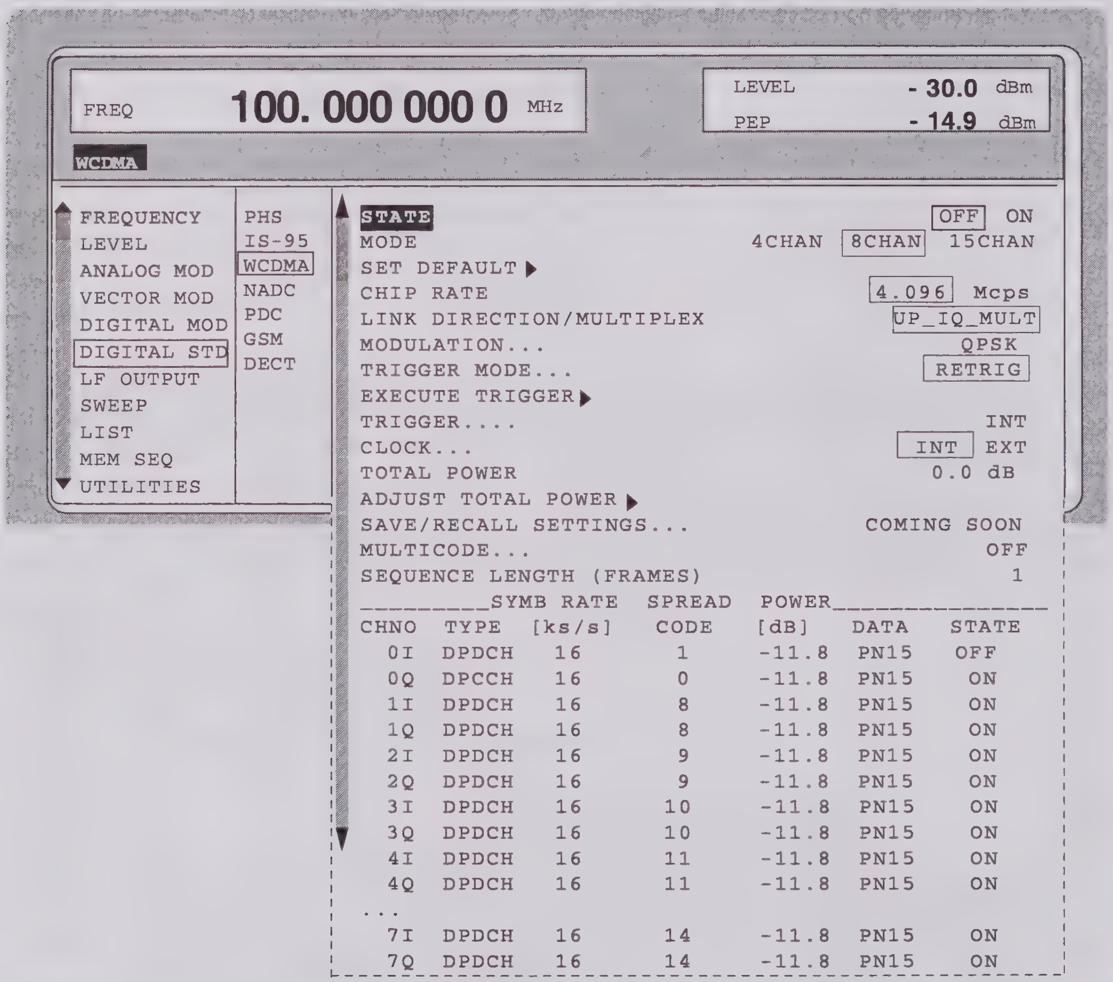
Switch on/off of assigned code channel.

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:STAT ON`

2.13.5 Menu W-CDMA Standard - Uplink Signals with IQ Multiplex

The settings for generating W-CDMA signals can be accessed via the menu DIGITAL STD - W-CDMA. The figure below shows the menu for generating the uplink signal with multiplex mode for the I and Q channel in the 8CHAN mode. The previous section shows the menu for generating the up and downlink signals without IQ multiplex as well as the parameters which are identical for all modes.

Selection: DIGITAL STD - WCDMA- MODE -8CHAN, -LINK DIRECTION/MULTIPLEX - UP_IQ_MULT



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 14.9 dBm

STATE [✓ OFF] ON

MODE 4CHAN [✓ 8CHAN] 15CHAN

SET DEFAULT ▶

CHIP RATE 4.096 Mcps

LINK DIRECTION/MULTIPLEX UP_IQ_MULT

MODULATION... QPSK

TRIGGER MODE... RETRIG

EXECUTE TRIGGER ▶

TRIGGER.... INT

CLOCK... [✓ INT] EXT

TOTAL POWER 0.0 dB

ADJUST TOTAL POWER ▶

SAVE/RECALL SETTINGS... COMING SOON

MULTICODE... OFF

SEQUENCE LENGTH (FRAMES) 1

CHNO	TYPE	SYMB RATE [ks/s]	SPREAD CODE	POWER [dB]	DATA	STATE
0I	DPDCH	16	1	-11.8	PN15	OFF
0Q	DPCCH	16	0	-11.8	PN15	ON
1I	DPDCH	16	8	-11.8	PN15	ON
1Q	DPDCH	16	8	-11.8	PN15	ON
2I	DPDCH	16	9	-11.8	PN15	ON
2Q	DPDCH	16	9	-11.8	PN15	ON
3I	DPDCH	16	10	-11.8	PN15	ON
3Q	DPDCH	16	10	-11.8	PN15	ON
4I	DPDCH	16	11	-11.8	PN15	ON
4Q	DPDCH	16	11	-11.8	PN15	ON
...						
7I	DPDCH	16	14	-11.8	PN15	ON
7Q	DPDCH	16	14	-11.8	PN15	ON

Fig. 2-89 Menu DIGITAL STD - WCDMA - MODE - 8CHAN, -LINK DIRECTION/MULTIPLEX - UP_IQ_MULT, equipped with options modulation coder SMIQB20, data generator SMIQB11 and SMIQB43

Parameters STATE to SEQUENCE LENGTH see section " Menu W-CDMA Standard -Downlink and Uplink Signals without IQ Multiplex"

CHNO

Column title for the display of channel numbers.

I	Line for the parameters of the I channel
Q	Line for the parameters of the Q channel

TYPE

Opens a window for selecting the channel type. The channel type can be separately set for the I and Q channel.

DPDCH	Dedicated Physical Data Channel with data field DATA
DPCCH	Dedicated Physical Control Channel with data field Pilot and TPC

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:I:TYPE DPCC`

SYMBOL RATE

Opens a window for selecting the symbol rate. The admissible selection depends on the channel type selected (TYPE). Possible values for DPDCH are 16, 32, 64, 128, 256, 512 and 1024 ksymbol/s (ksymbols per second). The DPDCH type has a fixed symbol rate of 16 ksymbol/s.
The symbol rate can be separately set for the I and Q channel.

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:I:SRAT D16`

SPREAD CODE

Opens a window for the spread code settings. The first line of the window indicates the code channel for which the settings are done (SPREADING OF CHANNEL NO).
The long code settings are valid in common for the I and Q channel. For the short code of I and Q separate settings are possible within a channel number line.

SHORT CODE Entry value for the short code index.
The upper limit depends on parameters CHIP RATE, SYMBOL RATE.

IEC/IEEE `:SOUR:WCDM:CHAN4:I:SCOD 9`

LONG CODE INIT Entry value for initializing the long code generator in hexadecimal notation.

IEC/IEEE `:SOUR:WCDM:CHAN4:I:LCOD #H1`

LONG CODE OFFSET Entry value for a time shift of the long code with respect to the data symbols in units of chip duration.

IEC/IEEE `:SOUR:WCDM:CHAN4:I:LCOD:OFFS 5`

POWER	Input value for channel power POWER indicates the average power of the I or Q code channel component in relation to the power indicated in the LEVEL display (Code Domain Power). The setting values for the I and Q code channels having the same channel number should always be identical. For MODE - 4CHAN - the power of channels 0, 1, 2 and 3 is set separately. For MODE - 8CHAN - the power of channel 0 is set separately. - the other channels have the same power. The power for all the channels is set, for instant, in channel 1. For MODE - 15CHAN - Since all channels have the same power, they cannot be set. POWER is only a display parameter in this case. When this value is modified, the value of TOTAL POWER is automatically adapted if STATE = ON. IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:I:POW -6`
DATA...	Opens a window for selecting data sources and setting a data offset. The first line of the window indicates the code channel for which the settings are done (DATA CONFIGURATION OF CHANNEL NO). The data source, the data offset and TPC can be separately set for the I and Q channel.

DATA	Selection of the data source for the DATA field of a DPDCH channel.	
	PN..	PRBS data to CCITT with period lengths between 2^9-1 and 2^{16}-1.
	DLIST	Data from a list previously programmed and stored. Programming is performed in the menu DIGITAL MOD - SOURCE - EDIT DATA LIST
	IEC/IEEE-bus `:SOUR:WCDM:CHAN4:I:DATA PN15`	
DATA OFFSET	Entry value for a data offset in units of symbol duration. The admissible range is as large as the length of a radio frame. The entry of a data offset shifts in time the modulation data with respect to the spread code. IEC/IEEE-bus `:SOUR:WCDM:CHAN4:I:DATA:OFFS 2`	

(DATA...) **TPC**

Selection of the data source for the TPC field of a DPDCH channel.

0	0 data are continuously generated
1	1 data are continuously generated
ALT	The TPC field is alternately assigned with 1 or 0 from slot to slot. (The first slot contains 1 data).
DLIST	Data from a list previously programmed and stored. Programming is performed in the menu DIGITAL MOD - SOURCE - EDIT DATA LIST

IEC/IEEE-bus `:SOUR:WCDM:CHAN4:I:TPC ZERO`

STATE

Activation or deactivation of the I or Q component of the assigned code channel. The I or Q component of channels with common power-up should always have the same state ON or OFF.

IEC/IEEE-bus command `:SOUR:WCDM:CHAN4:I:STAT ON`

2.14 Digital Standard 3GPP W-CDMA (FDD)

The SMIQ can generate 3GPP W-CDMA signals provided that the SMIQ is equipped with the following options: Modulation Coder (SMIQB20), Data Generator (SMIQB11) and Digital Standard 3GPP W-CDMA (SMIQB45). Section 2.14.1 gives an overview of this mobile radio transmission method. Section 2.14.2 describes the associated operating functions. Section 2.14.3 provides in-depth information about the generation of 3GPP W-CDMA signals.

2.14.1 Description of the Standard and its System Components

W-CDMA (wideband CDMA) designates a group of mobile radio transmission methods which differ in numerous details. Since none of these transmission methods has become a real standard so far, the SMIQ provides a version developed by the 3 GPP standard organization ("3rd Generation Partnership Project").

This version can be regarded as a synthesis of the IMT-2000 proposal as proposed by

- TheAssociation of Radio Industries and Businesses (ARIB) and
- The European Telecommunications Standards Institute (ETSI)

and is therefore also the successor of version NTT DoCoMo 1.0 implemented in digital standard W-CDMA (SMIQB43).

The current version (5.10 or higher) supports W-CDMA to 3GPP in versions 2.0.0 and 2.1.0 (FDD mode). The proposals of the "Operators' Harmonization Group" (OHG) are also included, whenever this is possible.

References:

[1] 3GPP TS 25.211 Physical channels and mapping of transport channels onto physical channels
[2] 3GPP TS 25.213 Spreading and modulation
[3] OHG Annex A to R1-99738
[4] 3GPP TSG-RAN WG1 #5(99)677

The SMIQ simulates 3GPP W-CDMA at the physical channel layer. The following description is, therefore, limited to this layer.

Table 2-18 Important 3GPP W-CDMA parameters

Chip rates	3.84 Mcps, 4.096 Mcps, 8.192 Mcps and 16.384 Mcps
Channel types	Downlink : Perch Channel (=Primary Common Control Physical Channel PCCPCH + Primary Synchronization Channel P-SCH + Secondary Synchronization Channel S-SCH), Secondary Common Control Physical Channel SCCPCH, Dedicated Physical Channel DPCH Uplink : Physical Random Access Channel PRACH, Dedicated Physical Data Channel DPDCH, Dedicated Physical Control Channel DPCCH
Symbol rates	8 ksps, 16 ksps, 32 ksps to 1024 ksps, 2048 ksps, 4096 ksps depending on type of channel *At the chip rate of 3.84 Mcps, the effective symbol rates are reduced by the factor of 15/16. Only the nominal symbol rates are indicated.*
Number of channels	Up to 512 (+ special channels) distributed between 4 base stations or mobile stations.
Frame structure	Time Slot: 0.625 ms, Radio frame: 16 time slots = 10 ms, Super frame: 72 radio frames = 720 ms The structure of the frames depends on the symbol rate. *For the chip rate of 3.84 Mcps, the time slot is extended to 0.667 ms, the radio frame consists of 15 time slots.*
Long code (="Scrambling code")	Downlink: 18 bit M sequence Uplink: 41 bit M-sequence (3GPP 2.0.0) or 25 bit M-sequence (3GPP 2.1.0)
Spreading code for all symbols of PCCPCH, SCCPCH, DPCH, DPDCH, DPCCH and message part of PRACH	"Layered orthogonal code" Orthogonal matrix of *chip rate/symbol rate*
Spreading code for SCH	One of 32 possible sequences with a length of 256 chips "Generalized Hierarchical Golay Sequence".
Spreading code for preamble of PRACH	8 bit M-sequence (with zero insertion)

System Components

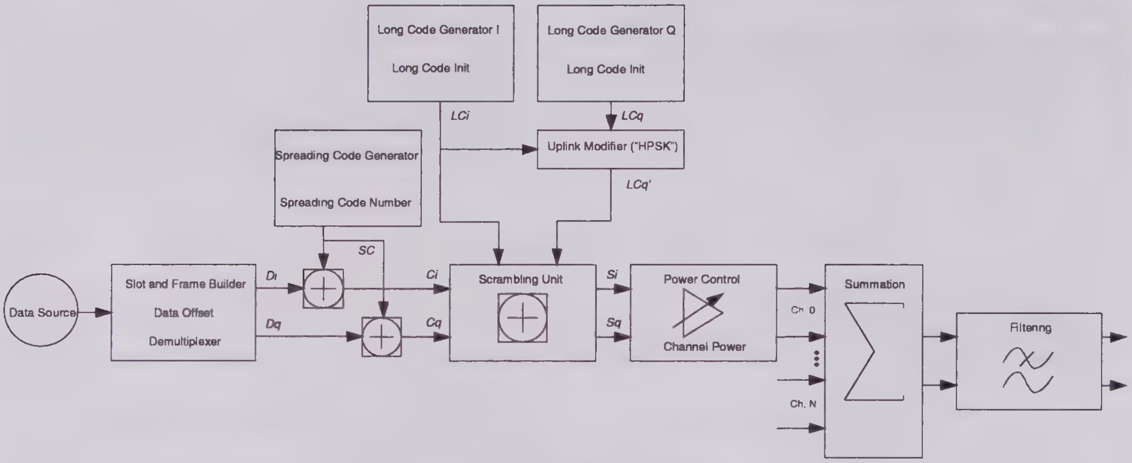


Fig. 2-90 Components of 3GPP W-CDMA transmission system

The individual functional blocks are:

Long code generator

The long code generator is also referred to as a scrambling code generator since it scrambles the chip sequence in a way that depends on the transmitter.

It comprises a pair of shift registers whose outputs are EXORed (M sequence). There are separate generators for the in-phase and the quadrature components, the two generators being of identical design however. The generator polynomials depend on the link direction and on the version of the 3GPP standard:

Table 2-19 Generating polynomials for long code generators (3GPP 2.0.0)

Link direction	Downlink	Uplink
Shift register 1	$x^{18}+x^7+1$	$X^{41}+x^3+1$
Shift register 2	$x^{18}+x^{10}+x^7+x^5+1$	$X^{41}+x^{20}+1$

Table 2-20 Generating polynomials for long code generators (3GPP 2.1.0)

Link direction	Downlink	Uplink
Shift register 1	$x^{18}+x^7+1$	$X^{25}+x^3+1$
Shift register 2	$x^{18}+x^{10}+x^7+x^5+1$	$X^{25}+x^3+x^2+x+1$

The shift registers are initialized by loading shift register 1 with the "Long Code Init" value and shift register 2 with 1s.

Note: *Instead of the expression "Long Code Init", "Long Code Number", "Long Code" or "Scrambling Code" are also used in the literature (see also references [1],[2]).*

Before the bits are taken from the generator for the quadrature component, this generator idles for a certain number of cycles (IQ offset). The number of idle cycles depends on the chip rate, the link direction and the 3GPP version.

Table 2-21 IQ Offset in Chips (3GPP 2.0.0)

Link Direction	**Downlink**	**Uplink**
3,84 Mcps	3360	3360
4,096 Mcps	3584	3584
8,192 Mcps	7168	7168
16,384 Mcps	14336	14336

Table 2-22 IQ Offset in Chips (3GPP 2.1.0)

Link Direction	**Downlink**	**Uplink**
3,84 Mcps	131072	3360
4,096 Mcps	131072	3584
8,192 Mcps	131072	7168
16,384 Mcps	131072	14336

After a cycle time of one radio frame, the generators are reset, ie the above initialization is carried out again.

In the uplink, the sequence of the Q component is modified to reduce the crest factor of the signal. Zero-crossings can then be avoided for every second chip thanks to this method. (This method is often called "HPSK").
For details see [2], section 4.3.2.1. SMIQ uses a decimation factor of 2.
This modification is not available in downlink and the following applies: $LC_q' = LC_q$.

Note: *The "Short scrambling code"described in [2], section 4.3.2.3 is currently not implemented.*

Scrambling Unit
In the scrambling unit, the output of the long code generator and the spread symbols are combined. If the input signal and the long code signal are interpreted as complex numbers (C_i, C_q, LC_i, $LC_q' \in \{-1, +1\}$), the output signal is obtained by multiplying the two signals together:

$$S_i + j\,S_q = (C_i + j\,C_q) * (LC_i + j\,LC_q')$$

This gives:

$$S_i = C_i LC_i - C_q LC_q'$$
$$S_q = C_i LC_q' + C_q LC_i$$

The signal obtained in this way has a constellation diagram like a QPSK signal:

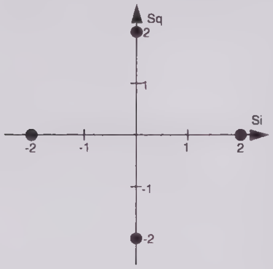


Fig. 2-91 Constellation of a channel with 0 dB power

Note: *There are auxiliary conditions for some types of channels that may result in different constellation diagrams.*
If, for instance, symbols of SCH or preamble part of PRACH are coded, a BPSK constellation is obtained without the scrambling unit. For an explanation of the different constellation diagrams see section 2.14.3.

Spreading Code Generator

The spreading code generator cyclically outputs a channel-specific bit pattern. The length of the cycle corresponds to the duration of the source symbol to be spread, ie the number of bits corresponds to the spread factor. The spreading sequence for the I and Q branches is identical (real). Spreading itself is a simple EXOR operation.
Three different spreading code generators are used depending on the type of channel.

Spreading Code Generator DPCH, DPDCH, DPCCH, PCCPCH, SCCPCH, PRACH (Message Part)

Using this spreading code, the channels in the sum signal can be seprated. The spreading code number is the row in an orthogonal spreading matrix which is generated by an iterative process.

Spreading Code Generator SCH

This generator replaces the one described above if the synchronization code symbol of the SCH channels is spread.
The spreading matrix is replaced by a method that forms the spreading sequence from a Hadamard sequence and a static sequence. For details see reference [2], section 5.2.3.1.

Spreading Code Generator PRACH (Preamble Part)

This generator is used for symbols of the preamble part of PRACH. The spreading sequence consists of a coupled shift register pair (8-bit M-sequence). For details, see reference [2], section 5.3.3.1.

Data source

The data source used in the SMIQ is implemented at the physical layer. There is no mapping of logical channels to physical channels nor is inner coding/outer coding performed.

Slot and frame builder

The bits from the data source are first inserted into a frame structure. The frames comprise three hierarchical levels:

Table 2-23 Hierarchical structure of 3GPP W-CDMA frames

Hierarchy	**Length in ms**	**Remark**
Time slot	0.625 (0.667 at 3.84 Mcps)	Time slots are the basic unit in the SMIQ.. The sequence length is given in time slots.
Radio frame	10	After a radio frame, pilot symbols are repeated. Also the length of a long code cycle.
Super frame	720	The superframe has no significance for the physical layer and is therefore ignored in the following.

The structure of the time slots depends on the channel type and symbol rate.

The following components are distinguished:

- Pilot sequence
  The pilot sequence characterizes the time slot position within the radio frame and also depends on the symbol rate, transmit diversity and 3GPP version.
  Channel types DPCH, PCCPCH, SCCPCH, DPCCH and PRACH have a pilot sequence. The pilot sequence cannot be changed by the user.
- Synchronization Code Symbol
  The synchronization code symbol is the only symbol of SCH.
  It is permanently set to "11".
- TPC Symbol
  This symbol is used to control the transmit power. It is used in the DPCH and DPCCH. A bit pattern for the sequence of TPC symbols can be specified as a channel-specific pattern.
- Data Symbol
  These symbols carry the user information and are fed from the data source. They are used in DPCH, PCCPCH, SCCPCH, DPDCH and PRACH.
- Signature
  The signature is used in PRACH. 16 fixed bit patterns are defined - the user may select one.
- TFCI
  The transport format combination indicator is used in DPCH/DPCCH if the corresponding interface button is activated (Base Station Configuration, see section 2.14.2.5, Mobil Station Configuration, see section 2.14.2.6). In this case, a code sequence with the length of 32 is defined using the **TFCI** value which is also available there and distributed among 16 subsequent time slots.
- FBI
  Feedback indication bits are used only in the DPCCH.

Data Offset

The symbol stream can be time offset with respect to the other channels. To do this, a data offset can be entered in the channel table. The data offset gives the number of symbols by which the symbol stream is to be offset. As the SMIQ does not generate infinite symbol streams like a realtime system, this offset is implemented as a rotation.

Example illustrating a DPCH 32 ksps, 1 time slot, data offset = 4:

before:

11	11	11	11	00	01	10	11	00	10	01	11	11	01	00	01	10	11	01	00

after:

10	11	01	00	11	11	11	11	00	01	10	11	00	10	01	11	11	01	00	01

The use of the data offset usually reduces the crest factor of the total signal, since it is not always the same spreading chips S_c and scrambling chips LC_i/LC_q' that are applied to the pilot sequences of the channels.

Demultiplexer

In the downlink, the symbol stream is divided into two bit streams D_i and D_q before spreading. The symbol stream is split by allocating bits 1, 3, 5, to 2n-1 to the in-phase bit stream D_i, and bits 2, 4, 6, 2n to the quadrature bit stream D_q.
For the above example with data offset:

$$D_i = 1\,1\,0\,0\,1\,1\,1\,1\,0\,0\,1\,1\,0\,1\,0\,1\,1\,0\,0\,0$$
$$Dq = 0\,1\,1\,0\,1\,1\,1\,1\,0\,1\,0\,1\,0\,0\,1\,1\,1\,1\,0\,1$$

(lefthand bit is always the first one in the time sequence)

Independent data are used for the two paths in the uplink.

PRACH:	Preamble : Signature parallel to I and Q Message Part : Data to I, pilot and TFCI to Q
DPCCH:	all bits to I, Q always unused
DPDCH:	all bits are always to I **or** Q (depending on spreading code), the other path is unused

Power Control

After spreading and scrambling, a channel-specific power factor *p* is applied to the signal. The log value stated in the channel table refers to the level. A value of -6 dB therefore halves the level and the following diagram is the result (DPCH):

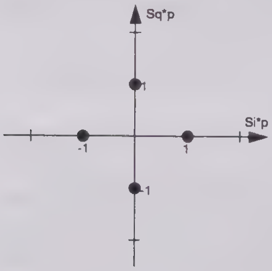


Fig. 2-92 Constellation diagram of a DPCH channel with -6 dB power

Summation

After application of the channel power, the magnitudes of the individual channels are summed.
The constellation diagram of the sum signal is obtained by superposing the diagrams of the individual channels. If the signal comprises two channels with powers of -6 dB and -12 dB and if each channel contains independent source data (DPCH), the following constellation diagram is obtained:

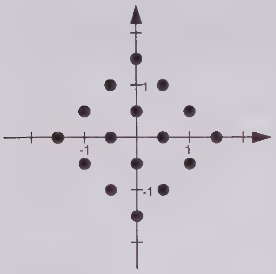


Fig. 2-93 Constellation diagram of a 3GPP W-CDMA signals with two DPCH channels

Filtering

An unfiltered, spread signal is obtained after summation. Filtering increases the number of samples by the oversampling factor and band limits the signal.

Multi Code

3GPP W-CDMA supports multicode transmission for downlink dedicated physical channels (DPCH) .
This form of transmission is used for channels used for the same receiver, ie receivers that belong to a radio link. The first channel of this group is used as a master channel.
Common components (pilot, TPC and TCFI) are spread for all channels using the spreading code of the master channel.

Note: *Instead of changing the spreading code in a slot several times, the master channel rather than the common components can be sent at increased power. The other channels then have to be blanked out.*

2.14.2 Generation of 3GPP W-CDMA Signals

The DIGITAL STD - WCDMA/3GPP menu is used to configure W-CDMA signals to the 3GPP standard (FDD). Up to 512 channels (distributed amomgst up to four base or mobile stations) can be simulated. The menu is hierarchical with several levels. This organizes the large number of parameters in a clear way.

There are also other menus with parameters that modify the W-CDMA signal. The following figure overviews all menus having anything to do with the W-CDMA signal and refers to related sections in the manual.

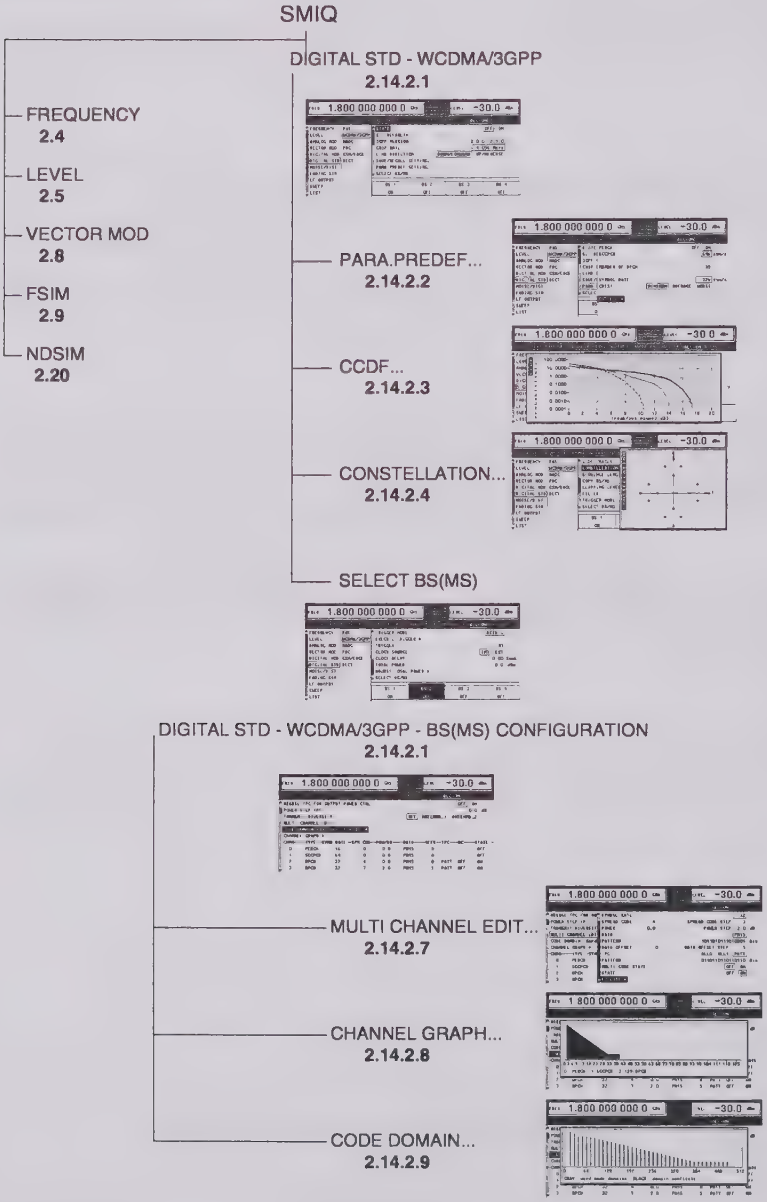
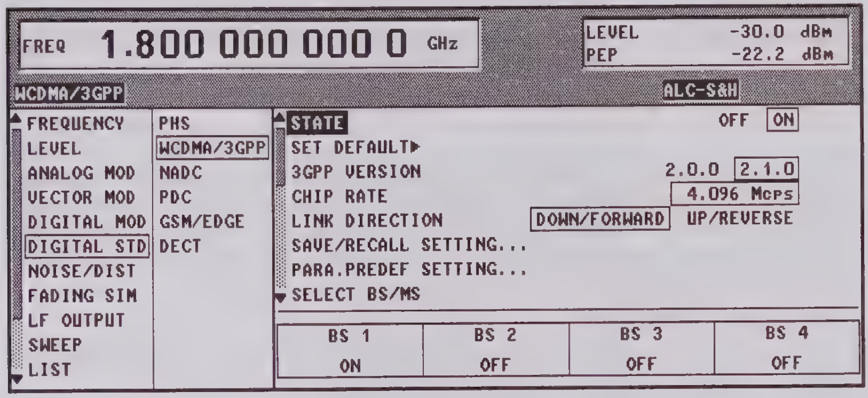


Fig. 2-94 Overview of DIGITAL STD – 3GPP WCDMA/3GPP menu structure

Note: *The parts of the DIGITAL STD – WCDMA/3GPP menu that are below the SELECT BS(MS) function are not required if a signal is parameterized by means of the PARA. PREDFEF function (see section 2.14.2.2).*

2.14.2.1 Menu WCDMA/3GPP

The following figure shows the menu for generating a downlink signal (transmit signal of base station).



FREQ 1.800 000 000 0 GHz

LEVEL -30.0 dBm

PEP -22.2 dBm

STATE OFF ON

3GPP VERSION 2.0.0 2.1.0

CHIP RATE 4.096 Mcps

LINK DIRECTION DOWN/FORWARD UP/REVERSE

BS 1	BS 2	BS 3	BS 4
ON	OFF	OFF	OFF

Fig. 2-95 DIGITAL STD - WCDMA/3GPP - Downlink

STATE Switch-on/off of modulation - digital standard 3GPP W-CDMA. If vector modulation, digital modulation or another digital standard were switched on, they are automatically switched off.

STATE = ON starts the calculation of a chip sequence based on current settings. The length of the chip sequence, and so the duration of the calculation, is determined by the SEQUENCE LENGTH parameter.

IEC/IEEE-bus command `:SOUR:W3GP:STAT ON`

Note : *When a parameter is changed, STATE is automatically switched to OFF to ensure that the set values and the output signal are consistent. After changing all the values, STATE can manually be set to ON. This is possible via menu parameter STATE and with the MOD ON/OFF key below the rollkey.*

SET DEFAULT ▶ Sets the default setup for 3GPP W-CDMA.

For further information about the default setting see section 2.14.2.14.

IEC/IEEE-bus command `:SOUR:W3GP:PRES`

3GPP VERSION Selection of current 3GPP version 2.0.0 or 2.1.0. Amongst other things, the two versions have different pilot patterns and calculate the long code sequences in different ways.

IEC/IEEE-bus command `:SOUR:W3GP:VERS V210`

CHIP RATE The following rates can be selected: 3.84 Mcps, 4.096 Mcps, 8.192 Mcps and 16.384 Mcps. The CHIP RATE selection has an effect on the ranges of many other parameters. When the CHIP RATE is changed, the CHIP RATE VARIATION (in FILTER... submenu) is also set to the value of the new chip rate.

IEC/IEEE-bus command `:SOUR:W3GP:CRAT R4M`

LINK DIRECTION

Selecting the link direction:

DOWN/FORWARD — Activates downlink-signal generation. In this mode, the base-station transmit signal can be generated.

IEC/IEEE-bus command `:SOUR:W3GP:LINK FORW`

UP/REVERSE — Activates uplink-signal generation. In this mode, the mobile-station transmit signal can be generated.

IEC/IEEE-bus command `:SOUR:WCDM:LINK REVE`

SAVE/RECALL...

The SMIQ supports two parallel SAVE/RECALL memory systems: The SAVE and RCL hardkeys are used to handle the frequency, level and state in the 3GPP W-CDMA menu. Menu selection SAVE/REALL, however, manages all the other parameters in the 3GPP W-CDMA menu. This also includes station-specific parameters such as the channel table.

RECALL SETTING — Recalling a saved configuration.

IEC/IEEE bus `:SOUR:W3GP:SETT:LOAD "MYSETUP"`

SAVE SETTING — Saving the current configuration.
An existing setting can be overwritten or a new setting can be created. The name of the new setting is assigned automatically, eg WCDMASEQ1.
If the setting is created via the IEC/IEEE bus, the name is user-selectable; the usual restrictions apply.

IEC/IEEE bus `:SOUR:W3GP:SETT:STOR "MYSETUP"`

DELETE SETTING — Deleting a configuration.

IEC/IEEE bus `:SOUR:W3GP:SETT:DEL "MYSETUP"`

PARA. PREDEF.

Calling parameterized predefined settings. For a description of this function see section 2.14.2.2.

CCDF

A complementary cumulative distribution function is calculated and displayed using the signal in the waveform memory. For details see section 2.14.2.3.

CCDF TRACES

The number of simultaneously displayed CCDF traces can be set. For details see section 2.14.2.3.

CONSTELLATION

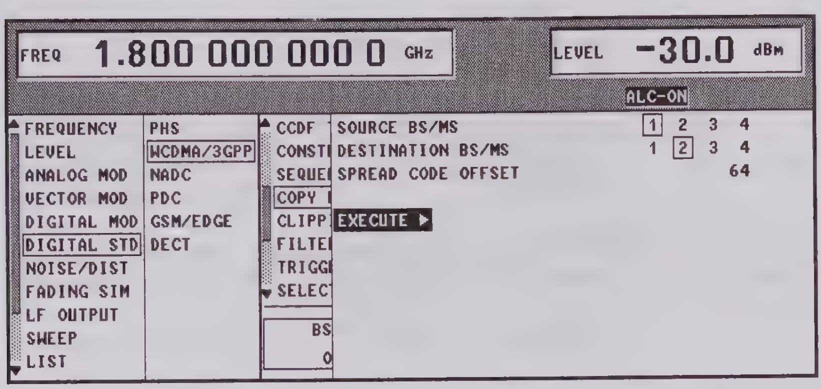
The constellation diagram for the signal in the waveform memory is calculated and displayed. For details see 2.14.2.4.

SEQUENCE LENGTH (FRAMES)

The sequence length can be set. The maximum length depends on the chip rate:

3.84 Mcps:	13 frames
4.096 Mcps:	12 frames
8.192 Mcps:	6 frames
16.384 Mcps:	3 frames

IEC/IEEE-bus command `:SOUR:W3GP:SLEN 4`



SOURCE BS/MS 1 2 3 4
DESTINATION BS/MS 1 2 3 4
SPREAD CODE OFFSET 64

Fig. 2-96 DIGITAL STD – WCDMA/3GPP – Downlink – COPY BS(MS) menu

COPY BS(MS)... Using COPY BS (MS) it is easy to create a new base/mobile station from an existing station. This feature is useful, say, when base stations with more than 128 data channels are to be simulated. For examples, see section 2.14.3.5.

SOURCE BS/MS For selecting the BS(MS) whose parameter set is to be copied. Possible values are 1, 2, 3 or 4.

IEC/IEEE-bus command `:SOUR:W3GP:COPY:SOUR 1`

DESTINATION BS/MS For selecting the destination BS(MS) whose parameter set is to be overwritten. Possible values are 1, 2, 3 or 4.

IEC/IEEE-bus command `:SOUR:W3GP:COPY:DEST 2`

SPREAD CODE OFFSET Offset used for the spreading codes during copying from the source BS(MS) to the destination BS(MS). The minimum value is 0, the maximum value is the maximum possible spreading code for the current chip rate and the link direction.

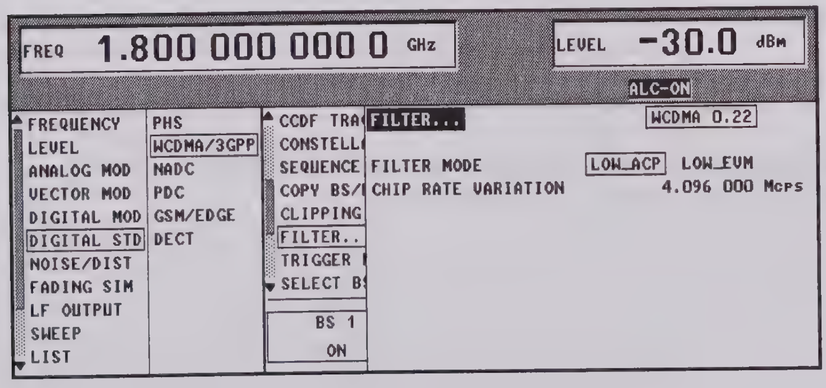
IEC/IEEE-bus command `:SOUR:W3GP:COPY:SOFF 123`

EXECUTE ▶ Starts copying.

IEC/IEEE-bus command `:SOUR:W3GP:COPY:EXEC`

CLIPPING LEVEL Sets a clipping level relative to the highest peak in per cent. The value range is 1 to 100 %. A value of 100% means that the signal is not clipped. Clipping reduces the crest factor. For background information on how to use this parameter see section 2.14.2.12.

IEC/IEEE-bus command `:SOUR:W3GP:CLIPP:LEV 50`



FILTER MODE LOW_ACP LOW_EVM
CHIP RATE VARIATION 4.096 000 Mcps

Fig. 2-97 DIGITAL STD – WCDMA/3GPP – FILTER... menu

FILTER...

FILTER

Selects the baseband filter.
Either the W-CDMA standard filter WCDMA 0.22 or the general Nyquist filters COS and SQRCOS can be selected. The optimized square-root cosine filter WCDMA 0.22 is preset. Its roll-off factor is fixed at 0.22.

IEC/IEEE-bus `:SOUR:W3GP:FILT:TYPE WCDM`

ROLL OFF FACTOR

Value set for the roll-off factor. The setting is only possible if a COS or SQRCOS filter was selected under FILTER.

IEC/IEEE-bus `:SOUR:W3GP:FILT:PAR 0.22`

FILTER MODE

Selection of filter mode.

LOW_ACP Filter for lowest adjacent-channel power

IEC-bus `:SOUR:W3GP:FILT:MODE LACP`

LOW_EVM Filter for lowest error vector magnitude

IEC-bus `:SOUR:W3GP:FILT:MODE LEVM`

CHIP RATE VARIATION

Input value of chip clock frequency. The value for CHIP RATE from the main menu is preset. CHIP RATE VARIATION changes the output clock, the modulation bandwidth and the output sync signals. It has no effect on the calculated chip sequence. The range is 100 cps to 18 Mcps.

IEC/IEEE-bus `:SOUR:W3GP:CRAT:VAR 4096001`

TRIGGER MODE

Configuration of W-CDMA sequence control (see section 2.14.2.13)

AUTO
The calculated W-CDMA chip sequence is immediately output and repeated cyclically. Trigger events are ignored.
IEC/IEEE-bus command `:SOUR:W3GP:SEQ AUTO`

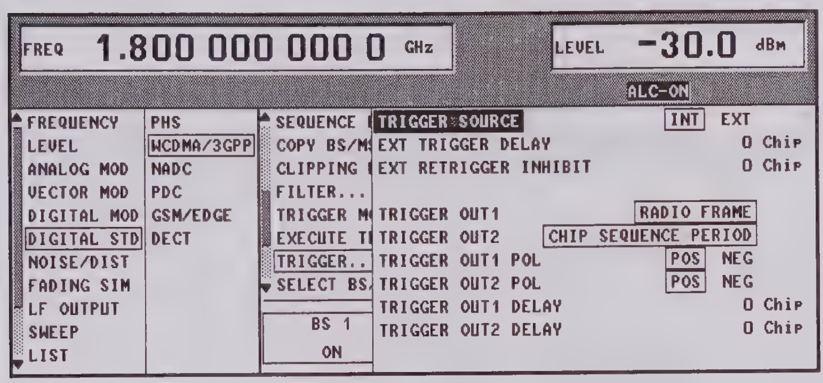
RETRIG
The calculated W-CDMA chip sequence is immediately output and repeated cyclically. A trigger event causes a restart from frame 1.
IEC/IEEE-bus command `:SOUR:W3GP:SEQ RETR`

ARMED_AUTO
Only a trigger event results in the W-CDMA chip sequence being started from frame 1. Other trigger events are ignored.
IEC/IEEE-bus command `:SOUR:W3GP:SEQ AAUT`

ARMED_RETRIG
Only a trigger event results in the W-CDMA chip sequence being started from frame 1. Each further trigger event causes a restart.
IEC/IEEE-bus command `:SOUR:W3GP:SEQ ARET`

EXECUTE TRIGGER ▶

Executes a trigger event at the start of the W-CDMA chip sequence.
IEC/IEEE-bus command `:TRIG:DM:IMM`



FREQ 1.800 000 000 0 GHz
LEVEL -30.0 dBm
ALC-ON

TRIGGER SOURCE INT EXT
EXT TRIGGER DELAY 0 Chip
EXT RETRIGGER INHIBIT 0 Chip
TRIGGER OUT1 RADIO FRAME
TRIGGER OUT2 CHIP SEQUENCE PERIOD
TRIGGER OUT1 POL POS NEG
TRIGGER OUT2 POL POS NEG
TRIGGER OUT1 DELAY 0 Chip
TRIGGER OUT2 DELAY 0 Chip

Fig. 2-98 DIGITAL STD – WCDMA/3GPP – TRIGGER...menu

TRIGGER...

Opens a window to select the trigger source, to configure trigger output signals and to set the delay of an external trigger signal (see also section 2.14.2.13).

TRIGGER SOURCE

For selecting the trigger source.

EXT The W-CDMA chip sequence is started from frame 1 on the active edge of an external trigger signal. The polarity, the trigger threshold and the input resistance of the TRIGIN input can be changed in the DIGITAL MOD - EXT INPUTS menu.

INT A trigger event is activated manually by EXECUTE TRIGGER.

IEC/IEEE-bus `:SOUR:W3GP:TRIG:SOUR EXT`

EXT TRIGGER DELAY

For setting the number of chips by which an external trigger signal is delayed before it starts the W-CDMA chip sequence This is used to set up synchronization with the DUT or other units.

IEC/IEEE-bus `:SOUR:W3GP:TRIG:DEL 3`

EXT RETRIGGER INHIBIT

Sets the number of chips by which a restart is delayed after a trigger event. If the RETRIG TRIGGER MODE was selected, every further trigger signal restarts the W-CDMA chip sequence. This restart is inhibited for the number of chips that have been entered.

Example:
The effect of entering 82000 chips is that any further trigger signal is ignored for 82000 chips after a trigger event.

IEC/IEEE-bus `:SOUR:W3GP:TRIG:INH 82000`

(TRIGGER...)

TRIGGER OUT 1/2

For selecting signals for outputs TRIGOUT 1 and TRIGOUT 2 in the PARDATA connector.
The times only apply if the internal clock generation frequency was not modified with the CHIP RATE VARIATION parameter.

SLOT	0.625 ms slot clock IEC/IEEE-bus command: `:SOUR:W3GP:TRIG:OUTP1 SLOT`
RADIO FRAME	10 ms frame clock IEC/IEEE-bus command: `:SOUR:W3GP:TRIG:OUTP1 RFR`
CHIP SEQUENCE	Marker signal for identifying the periodic repetition of the generated chip sequence. IEC/IEEE-bus command: `:SOUR:W3GP:TRIG:OUTP1 CSP`

TRIGGER OUT 1/2 POL

Selects the polarity of signals at the TRIGOUT 1 and TRIGOUT 2 outputs in the PARDATA connector.

IEC/IEEE-bus `:SOUR:W3GP:OUTP2:POL POS`

TRIGGER OUT 1/2 DELAY

Input value of number of chips by which the selected trigger output signal is delayed.
IEC/IEEE-bus `:SOUR:W3GP:OUTP2:DEL 0`

CLOCK SOURCE

Allows the selection of the clock source for the chip clock (see sect. 2.14.2.13).

INT	SMIQ operates with internally generated clock signals.
EXT	A chip clock has to be fed in externally at the SYMBOL CLOCK connector. The CHIP RATE parameter must be set with an accuracy of ± 1 %. The polarity, the trigger threshold and the input resistance of the SYMBOL CLOCK input can be changed in DIGITAL MOD - EXT INPUTS menu.

IEC/IEEE-bus command `:SOUR:W3GP:CLOC:SOUR INT`

CLOCK DELAY

Setting the delay of generated modulation signal to an external clock. This can be used, for example, for synchronization with a second unit to achieve time synchroneity between the modulation signals of the two units. The displayed setting resolution of 1/100 symbol is only attained for symbol-clock frequencies below 100 kHz. The resolution is reduced with increasing frequency. At a chip rate of 1.2288 Mcps, the resolution equals the chip duration × 0.1.

IEC/IEEE-bus `:SOUR:W3GP:CLOC:DEL 0.5`

TOTAL POWER

Displays the total power of activated code channels. The total power is calculated from the power ratio of the activated code channels with the modulation switched on (STATE=ON). If the value is not equal to 0 dB, the individual code channels are internally adjusted (while maintaining the power ratios) so that the TOTAL POWER is 0 dB to obtain the output level (LEVEL) set in the header of the display. In addition to the average power, the peak envelope power (PEP) is also displayed.

IEC/IEEE-bus command `:SOUR:W3GP:POW?`

ADJUST TOTAL POWER ▶

Changes the power of every activated code channel so that the TOTAL POWER returns to 0 dB again, while the ratio of the powers of the individual code channels remains the same.
IEC/IEEE-bus command `:SOUR:W3GP:POW:ADJ`

SELECT BS/MS

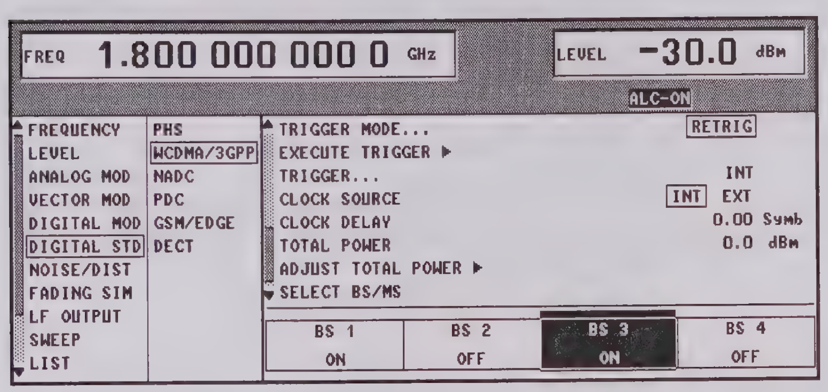


Fig. 2-99 DIGITAL STD – WCDMA/3GPP – SELECT BS(MS) menu

SELECT BS/MS has a special significance in the 3GPP W-CDMA menu: It is always displayed in the bottom line of the scrollable area, ie above the four station blocks. After selection of this menu item (**SELECT** hardkey), the cursor is positioned in the area below. The station whose parameters are to be edited can be selected by means of the spinwheel or the arrow keys.

Note : *The state of the BS/MS can also be toggled without selecting the station. Just move the cursor to the station and press the ENTER key.*

For editing the station parameters see section 2.14.2.5.

2.14.2.2 WCDMA/3GPP Menu - Para. Predef. Submenu

With the Para. Predef. function, it is possible to create highly complex scenarios with just a few keystrokes. This function is of use if, say, just the envelope of the signal is of interest.
What parameters are offered depends on the link direction.

Down/forward link :

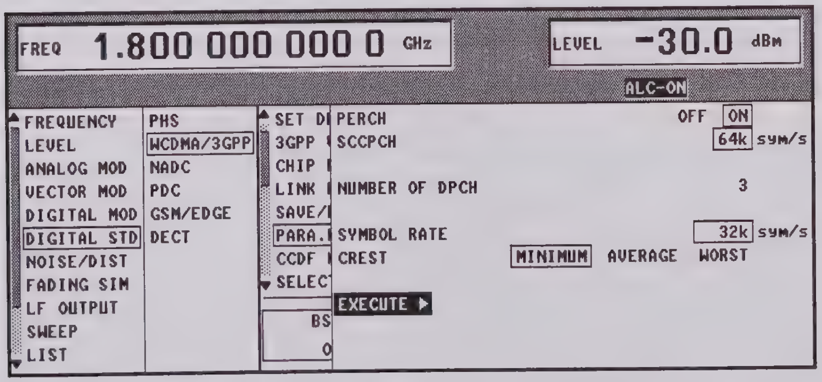


Fig. 2-100 DIGITAL STD - WCDMA/3GPP - PARA. PREDEF. Menu (forward link)

PERCH

ON — PERCH is used in the scenario.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:PERC ON`

OFF — PERCH is not used in the scenario.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:PERC OFF`

SCCPCH

OFF — SCCPCH is not used in the scenario.
IEC/IEEE-bus command
`:SOUR:W3GP:PPAR:SCCPCH:STAT OFF`

8k, 16k to 4096k — SCCPCH is used in the scenario at the stated symbol rate.
IEC/IEEE-bus commands
`:SOUR:W3GP:PPAR:SCCPCH:STAT ON`
`:SOUR:W3GP:PPAR:SCCPCH:SRAT D8K`

NUMBER OF DPCH

Number of DPCH in the scenario. The minimum number is 0. The maximum number is the ratio of the chip rate and the symbol rate - this number cannot, however, exceed 512, a limit set by the size of the channel table.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:DPCH:COUN 123`

SYMBOL RATE

Symbol rate of all DPCH. Possible values are 8k, 16k, 32k, 64k, 128k, 256k, 512k, 1024k, 2048k and 4096 k.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:DPCH:SRAT D32K`

CREST

The crest factor of the signal can be modified by setting appropriate spreading codes and data offsets.

MINIMUM: The crest factor is minimized (the spreading codes are distributed uniformally over the code domain. The data offsets are increased by 3 per channel).
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:CRES MIN`

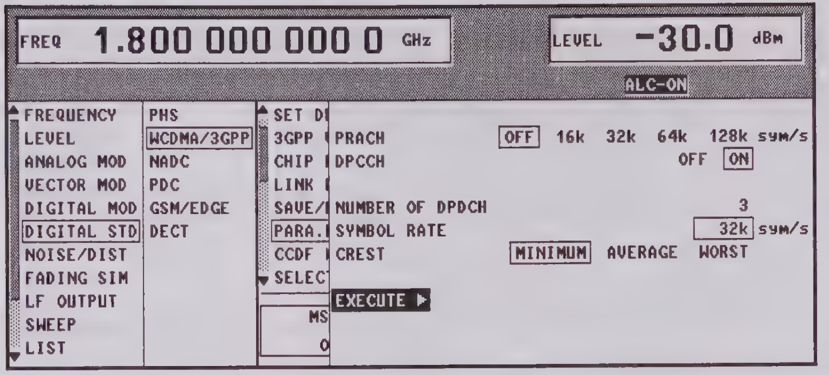
AVERAGE: An average crest factor is set (the spreading codes are distributed uniformally over the code domain. The data offsets are all set to 0).
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:CRES AVER`

WORST: The crest factor is set to an unfavourable value (ie maximum) (the spreading codes are assigned in ascending order. The data offsets are all set to 0.)
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:CRES WORS`

EXECUTE ▶

The channel table is automatically filled up with the parameters that have been set.

Up/reverse link:



PRACH OFF 16k 32k 64k 128k sym/s
DPCCH OFF ON
NUMBER OF DPDCH 3
SYMBOL RATE 32k sym/s
CREST MINIMUM AVERAGE WORST

Fig. 2-101 DIGITAL STD – WCDMA/3GPP – PARA. PREDEF. menu (reverse link)

PRACH

OFF — PRACH is not used in the scenario.
IEC/IEEE-bus command
`:SOUR:W3GP:PPAR:PRAC:STAT OFF`

16k,32k,64k,128k — PRACH is used in the scenario with the stated symbol rate.
IEC/IEEE-bus command
`:SOUR:W3GP:PPAR:PRAC:STAT ON`
`:SOUR:W3GP:PPAR:PRAC:SRAT D32K`

DPCCH

ON — DPCCH is used in the scenario.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:DPCC ON`

OFF — DPCCH is not used in the scenario.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:DPCC OFF`

NUMBER OF DPDCH

The number of DPDCH in the scenario. The minimum number is 0. The maximum number is the ratio of the chip rate and the symbol rate - this number cannot, however, exceed 512, a limit set by the size of the channel table.

IEC/IEEE-bus command `:SOUR:W3GP:PPAR:DPDC:COUN 123`

SYMBOL RATE

Symbol rate of all DPDCH.
Possible values: 16k, 32k, 64k, 128k, 256k, 512k, 1024k, 2048k and 4096 k.

IEC/IEEE-bus command `:SOUR:W3GP:PPAR:DPDC:SRAT D32K`

CREST

By setting appropriate spreading codes and data offsets, the crest factor of the signal can be changed.

MINIMUM: The crest factor is minimized (the spreading codes are uniformly distributed over the code domain. The data offsets are increased by 3 per channel).
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:CRES MIN`

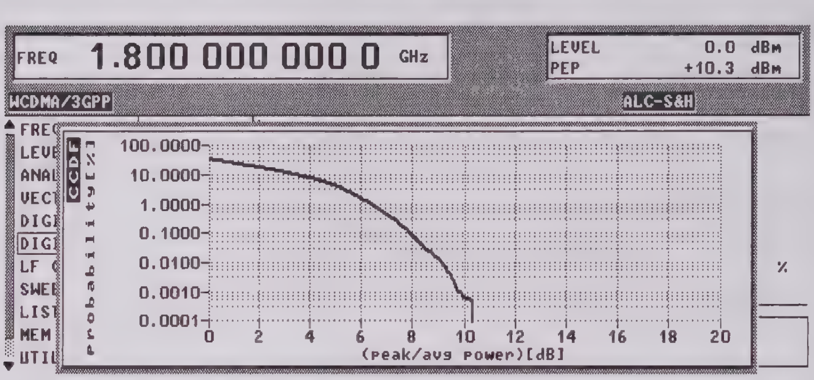
AVERAGE: An average crest factor is set (the spreading codes are distributed uniformly over the code domain. The data offsets are all set to 0).
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:CRES AVER`

WORST: The crest factor is set to an unfavourable value (ie maximum) (the spreading codes are assigned in ascending order. The data offsets are all set to 0.)
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:CRES WORS`

EXECUTE ▶

The channel table is automatically filled up with the parameters that have been set.

2.14.2.3 WCDMA/3GPP Menu- Display of CCDF



FREQ 1.800 000 000 0 GHz

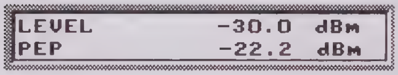
LEVEL 0.0 dBm
PEP +10.3 dBm

Fig. 2-102 DIGITAL STD – WCDMA/3GPP – CCDF menu with a trace

A complementary cumulative distribution function can be generated from the filtered I/Q samples. This function gives the probability of the magnitude of a complex sample exceeding a predefined threshold. The complete waveform, ie the sum for all (max. 4) stations is used to calculate the CCDF.

If this threshold is thought of as the radius of a circle centered on the origin, the radius is plotted along the horizontal axis and the probability of the samples lying outside this circle along the vertical axis. Only radii that correspond to values that are at least as great as the average power are considered.

The crest factor can be read off at the intersection of the trace with the x axis. The precise value is obtained from the displayed levels (PEP-LEVEL).



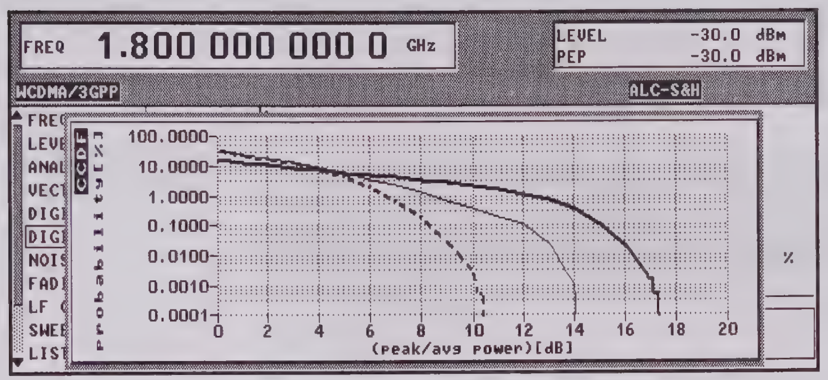
LEVEL -30.0 dBm
PEP -22.2 dBm

Fig. 2-103 Reading off the crest factor from LEVEL displays

In this example, the crest factor is 7.8 dB.

The number of simultaneously displayed traces can be set with the menu item NUMBER OF CCDF TRACES. Displaying several traces shows the effect of the parameters on the envelope. The baseband filter, the data offsets and the spreading codes in particular have an effect on the CCDF.

The last three traces are distiguished in the following way:
Current trace: ━━━━━
Last trace: ─────
Last but one trace: - - - - -


FREQ 1.800 000 000 0 GHz

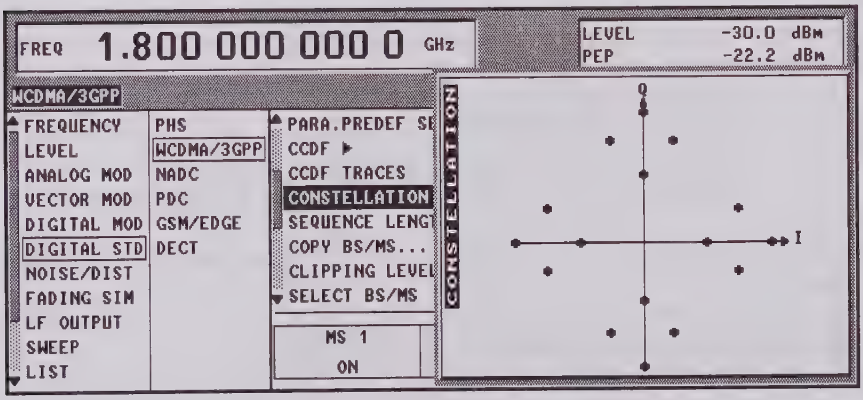
LEVEL -30.0 dBm

PEP -30.0 dBm

Fig. 2-104 DIGITAL STD – WCDMA/3GPP – CCDF menu with three traces

2.14.2.4 WCDMA/3GPP Menu – Displaying Constellation Diagrams

A constellation diagram can be calculated and displayed from the unfiltered I/Q samples (menu item CONSTELLATION).


FREQ 1.800 000 000 0 GHz

LEVEL -30.0 dBm

PEP -22.2 dBm

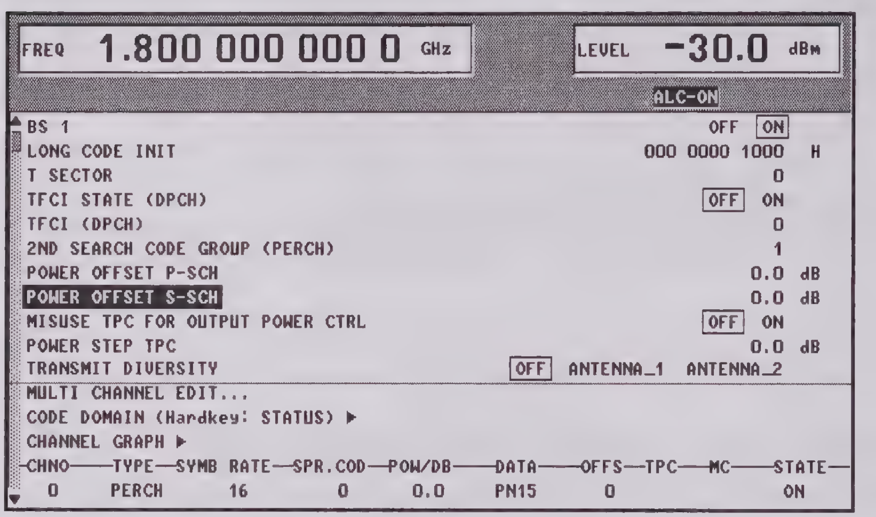
MS 1 ON

Fig. 2-105 DIGITAL STD - WCDMA/3GPP – CONSTELLATION menu

In addition to the code domain display (see section 2.14.2.9) and the CCDF display (see section 2.14.2.3) the constellation diagram is the most important display for a W-CDMA signal. In addition to channel powers, the effect of data sources etc and also the spreading scheme can be read off as a function of the type of channel. For further information on W-CDMA constellation diagrams see sections 2.14.3.1 and 2.14.3.2. The complete waveform, ie the sum for all (max.4) stations is used to calculate the constellation diagram.

2.14.2.5 WCDMA/3GPP Menu - BS Configuration Submenu

The channel configuration for each base station is performed in this window. In the upper part of the window, the parameters valid for the whole BS are set and the channel-specific parameters are set in the bottom part of the table.



```
FREQ  1.800 000 000 0 GHz                 LEVEL  -30.0 dBm
                                                 ALC-ON
BS 1                                                OFF  [ON]
LONG CODE INIT                               000 0000 1000  H
T SECTOR                                                0
TFCI STATE (DPCH)                                  [OFF]  ON
TFCI (DPCH)                                             0
2ND SEARCH CODE GROUP (PERCH)                           1
POWER OFFSET P-SCH                                    0.0  dB
POWER OFFSET S-SCH                                    0.0  dB
MISUSE TPC FOR OUTPUT POWER CTRL                   [OFF]  ON
POWER STEP TPC                                        0.0  dB
TRANSMIT DIVERSITY                    [OFF]  ANTENNA_1  ANTENNA_2
MULTI CHANNEL EDIT...
CODE DOMAIN (Hardkey: STATUS) ▶
CHANNEL GRAPH ▶
-CHNO---TYPE--SYMB RATE--SPR.COD--POW/DB---DATA---OFFS--TPC--MC---STATE-
  0     PERCH     16        0       0.0    PN15     0               ON
```

Fig. 2-106 DIGITAL STD - WCDMA/3GPP - BS CONFIGURATION menu

Parameters that are valid for the current base station:

BS 1(2,3,4) STATE

ON The BS is active. All other parameters are activated.
IEC/IEEE-bus command `:SOUR:W3GP:BMST1:STATE ON`

OFF The BS is inactive. The other parameters are ignored.
IEC/IEEE-bus command `:SOUR:W3GP:BMST2:STATE OFF`

LONG CODE INIT

Name of base station. At the same time, the initial value for the scrambling code generator.
Permissible values are in the range 0 to 0x3FFFF.
IEC/IEEE-bus command `:SOUR:W3GP:PPAR:LCOD #H1`

T SECTOR

Setting the sector offset of BS signal. Using this value, the component of the current BS can be time shifted with respect to the component of another BS. The unit is chips. The minimum value is 0, the maximum value is the number of chips per frame –1:

3.84 Mcps:	0 to 38399
4.096 Mcps:	0 to 40959
8.192 Mcps:	0 to 81919
16.384 Mcps:	0 to 163839

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:TSEC 40559`

TFCI STATE

ON TFCI field is used in the frame.
IEC/IEEE-bus command `:SOUR:W3GP:BMST1:TFCI:STATE ON`

OFF TFCI field is not used in the frame.
IEC/IEEE-bus command `:SOUR:W3GP:BMST2:TFCI:STATE OFF`

TFCI (DPCH)

Setting the TFCI value in the range 0 to 63. A combination of 32 bits is selected by this value. This combination is distributed over 16 successive slots in groups of two.

IEC/IEEE-bus command `:SOUR:W3GP:BMST4:TFCI 21`

2ND SEARCH CODE GROUP (PERCH)

This parameter indexes the "Spreading Code Allocation for 2nd SCH code" table described in the 3GPP standard [2], Table 9. For each slot in the frame, this table assigns a certain spreading code to the synchronization code symbol. The parameter's range is 1 to 34. The values 1 to 32 are used to select table rows group 1 to group 32 as defined in the standard. Table row [SYNC BTS] is selected with parameter value 33 and "All codes 1" with 34.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:SSCG 1`

POWER OFFSET P-SCH

POWER OFFSET S-SCH

The two synchronization channels P-SCH and S-SCH can be sent with a channel power that differs from the PERCH power. These parameters are powers relative to the power given in the channel table for the PERCH channel.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:POW:OFFS:PSCH 3.0`
IEC/IEEE-bus command `:SOUR:W3GP:BMST3:POW:OFFS:SSCH -1`

MISUSE TPC FOR OUTPUT POWER CONTROL

TPC bits are used for W-CDMA to tell the called station if the transmit power is being increased or decreased. If this field is marked, the given pattern is being misused to vary one's own transmit power over time. For each slot, one bit of this pattern is taken to increase (bit = 1) or decrease (bit = 0) the channel power by the stated power step (**POWER STEP TPC**). The upper limit is 0 dB and the lower –60 dB.
The following envelope is occurs at a channel power of 0 dB, a power step of 1.0 dB and with the pattern "001110100000011" :

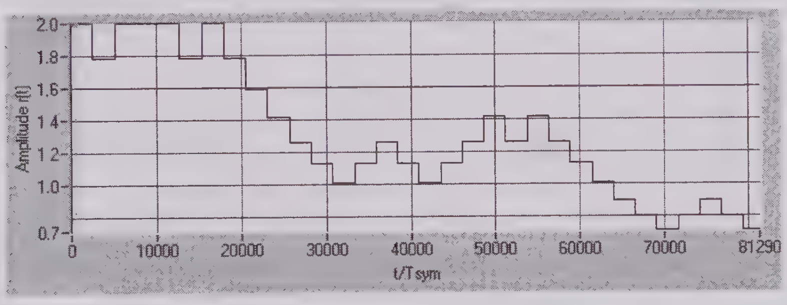


Fig. 2-107 Dynamic change of channel power

Note that the first bit is assigned to the first slot. The channel power is always taken from the table, ie the power change is cancelled for the first slot.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:TPC:MIS ON`

POWER STEP

Size of power step in dB, if option **MISUSE TPC FOR OUTPUT POWER CONTROL** is activated.
The range is –10.0 dB to +10.0 dB.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:POW:STEP 1.0`

ANTENNA DIVERSITY

The 3GPP standard describes various forms of transmit diversity. The signal is distributed with different coding between two antennas. The SMIQ can simulate the signal for one of the two antennas.
A fixed diversity scheme is assigned to each channel type.

DPCH, PCCPCH and SCCPH:	STTD (space time block coding transmit antenna diversity)
Primary and secondary SCH:	TSTD (time switched transmit diversity for SCH)

Both schemes are described in detail in reference [1], section 5.3.1.
If transmit diversity is required, the antenna whose signal is to be simulated can be specified.

OFF:	no transmit diversity
ANTENNA 1:	Calculate antenna signal for antenna 1 and display result.
ANTENNA 2:	Calculate antenna signal for antenna 2 and display result.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:TRAN:DIV ANT1`

MULTI CHANNEL EDIT...

A certain number of DPCHs can be configured with just a few keystrokes thanks to this menu item. For further information see section 2.14.2.7.

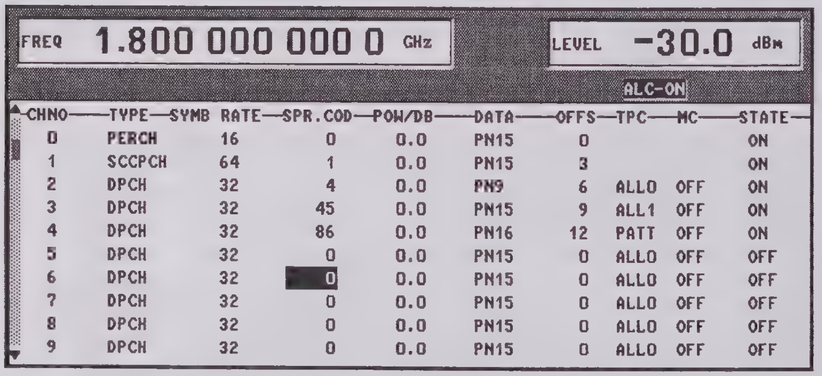
CHANNEL GRAPH

This menu item gives an overview of the assigned channels, see section 2.14.2.8.

CODE DOMAIN

This menu item indicates the assignment of code domain, see section 2.14.2.9.

Channel table:



FREQ 1.800 000 000 0 GHz

LEVEL -30.0 dBm

ALC-ON

CHNO	TYPE	SYMB RATE	SPR.COD	POW/DB	DATA	OFFS	TPC	MC	STATE
0	PERCH	16	0	0.0	PN15	0			ON
1	SCCPCH	64	1	0.0	PN15	3			ON
2	DPCH	32	4	0.0	PN9	6	ALL0	OFF	ON
3	DPCH	32	45	0.0	PN15	9	ALL1	OFF	ON
4	DPCH	32	86	0.0	PN16	12	PATT	OFF	ON
5	DPCH	32	0	0.0	PN15	0	ALL0	OFF	OFF
6	DPCH	32	0	0.0	PN15	0	ALL0	OFF	OFF
7	DPCH	32	0	0.0	PN15	0	ALL0	OFF	OFF
8	DPCH	32	0	0.0	PN15	0	ALL0	OFF	OFF
9	DPCH	32	0	0.0	PN15	0	ALL0	OFF	OFF

Fig. 2-108 DIGITAL STD – WCDMA/3GPP – BS CONFIGURATION / channel table menu

Below the general parameters of the current base station, there is a table comprising all the parameters that can be edited on a channel-specific basis.

CH NO

Channel number, consecutive from 0 to 129. This value cannot be edited. All rows are displayed even if the channels are inactive. Activating/deactivating is via STATE at the end of the row.

TYPE

Channel type which is permanently linked to the channel number and which cannot be edited:
CH NO 0: PERCH =
PCCPCH (Primary Common Control Physical Channel)
+ P-SCH (Primary Synchronisation Channel)
+ S-SCH (Secondary Synchronisation Channel)
CH NO 1: SCCPCH (Secondary Common Control Physical Channel)
CH NO 2 to 129: DPCH (Dedicated Physical Channel)

Not all parameters in the table can be edited. This depends on the type of channel.

SYMBOL RATE

Symbol rate of channel in ksym/s. The range depends on the type of channel.
PERCH: fix to 16k
SCCPCH, DPCH: 8k, 16k, 32k, 64k, 128k, 256k, 512k, 1024k (2048k, 4096k)

The two highest symbol rates are not specified in [1] but are still provided to ensure compatibility with old standards.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:SRAT 32K`

SPREAD CODE

Spreading code of channel. PERCH has a fixed spreading code of 0. The spreading codes for SCCPCH and DPCHs are between 0 and a maximum value that depends on the chip rate and symbol rate of the channel. These maximum values are listed in section 2.14.2.10.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:SRAT 32K`

POWER [DB]

Channel power in dB; range –60 to 0.0 dB. The stated power is relative to the powers of other channels and initially does not refer to the LEVEL power display. After activating **ADJUST TOTAL POWER ▶** (top level of 3GPP W-CDMA menu) all power readings as referred to LEVEL.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:POW -10.0`

DATA

Selects the data source for the DATA field.
Selection of PN9, PN11, PN15, PN16, ALL0, ALL1 and PATTern.
How the PN generator operates is explained in section 2.12.3, for example.
If the PATTern data type is used, the pattern can be modified with a special editor. The length is limited to 16 digits.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:DATA PN15`
IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:DATA:PATT #H1234`

DATA OFFSET

Data offset in the range 0 to 40959 symbols.

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:DATA:OFFS 5`

TPC

Selects the data source for the TPC field.

ALL0 All 0s are continuously entered in the TPC field.
IEC/IEEE-bus command `:SOUR:W3GP:BMST1:CHAN2:TPC ZERO`

ALL1 All 1s are continuously entered in the TPC field.
IEC/IEEE-bus command `:SOUR:W3GP:BMST2:CHAN129:TPC ONE`

PATT The TPC field is cyclically filled with a pattern that is up to 16 bits long. One bit is taken from this pattern per slot and, if necessary, reduplicated. A special pattern editor is displayed.
IEC/IEEE-bus commands
`:SOUR:W3GP:BMST2:CHAN5:TPC PATT`
`:SOUR:W3GP:BMST2:CHAN5:TPC:PATT #ADAC`

MC

ON This channel is to be simulated with multicode.
IEC/IEEE-bus command `:SOUR:W3GP:BMST1:CHAN2:MCOD ON`

OFF This channel is to be simulated without multicode.
IEC/IEEE-bus command
`:SOUR:W3GP:BMST2:CHAN99:MCOD OFF`

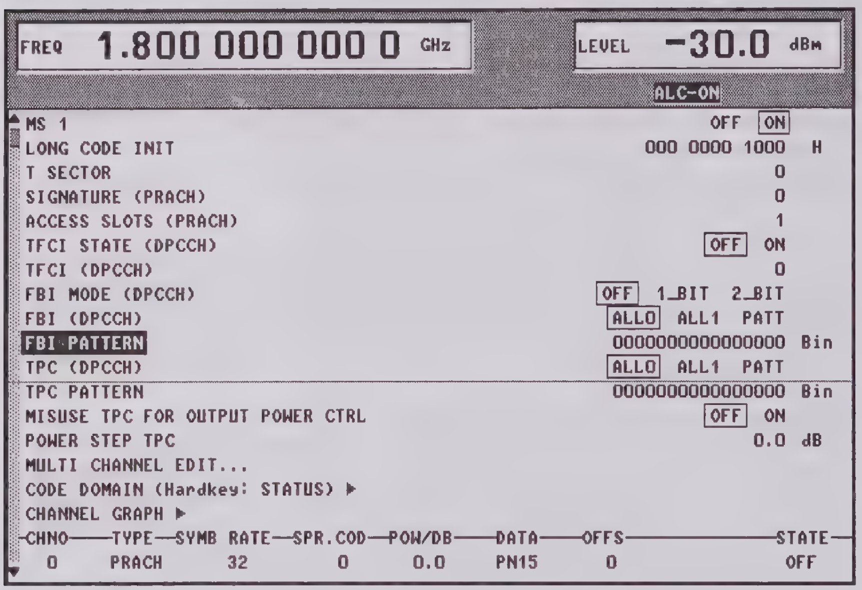
STATE

ON The channel is activated. All parameters in this row are active.
IEC/IEEE-bus command
`:SOUR:W3GP:BMST1:CHAN1:STATE ON`

OFF The channel is not active. All parameters in this row are ignored.
IEC/IEEE-bus command
`:SOUR:W3GP:BMST2:CHAN9:STATE OFF`

2.14.2.6 WCDMA/3GPP Menu - MS Configuration Submenu

The channels for each mobile station are configured in this window. The parameters for the whole MS are set in the upper part of the window and the channel-specific parameters are set in the bottom part of the table.



```
FREQ  1.800 000 000 0 GHz                    LEVEL  -30.0 dBm
                                                  ALC-ON
MS 1                                               OFF  [ON]
LONG CODE INIT                                000 0000 1000  H
T SECTOR                                                  0
SIGNATURE (PRACH)                                         0
ACCESS SLOTS (PRACH)                                      1
TFCI STATE (DPCCH)                                 [OFF]  ON
TFCI (DPCCH)                                              0
FBI MODE (DPCCH)                           [OFF]  1_BIT  2_BIT
FBI (DPCCH)                                 [ALL0]  ALL1  PATT
FBI PATTERN                              0000000000000000 Bin
TPC (DPCCH)                                 [ALL0]  ALL1  PATT
TPC PATTERN                              0000000000000000 Bin
MISUSE TPC FOR OUTPUT POWER CTRL                   [OFF]  ON
POWER STEP TPC                                       0.0 dB
MULTI CHANNEL EDIT...
CODE DOMAIN (Hardkey: STATUS) ▶
CHANNEL GRAPH ▶
CHNO----TYPE--SYMB RATE--SPR.COD--POW/DB----DATA----OFFS-----------STATE--
 0      PRACH    32         0       0.0     PN15     0              OFF
```

Fig. 2-109 DIGITAL STD – WCDMA/3GPP – MS CONFIGURATION menu

Parameters that are globally valid for current mobile station:

MS 1(2,3,4) STATE	ON	The MS is active. All other parameters are active. IEC/IEEE-bus command `:SOUR:W3GP:BMST1:STATE ON`
	OFF	The MS is not active. The other parameters are ignored. IEC/IEEE-bus command `:SOUR:W3GP:BMST2:STATE OFF`

LONG CODE INIT

Name of mobile station also the initial value for the scrambling code generator. Permissible values are in the range 0..0x1FF FFFF FFFF.

IEC/IEEE-bus command `:SOUR:W3GP:PPAR:LCOD #H1`

T SECTOR

Setting the sector offset of the MS signal. Using this value, the component of the current MS can be time-shifted with respect to the component of another MS. The unit is chips. The minimum value is 0, the maximum value is the number of chips per frame -1:

3.84 Mcps:	0 to 38399
4.096 Mcps:	0 to 40959
8.192 Mcps:	0 to 81919
16.384 Mcps:	0 to163839

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:TSEC 40559`

SIGNATURE (PRACH)

This field can be used to determine the signature to be used for the PRACH. The range of possible values is 0 to 16.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:SIGN 1`

ACCESS SLOT# (PRACH)

This parameter is used to shift the PRACH starting time. The range is 1 to 8. (The time-shift of the starting point in time slots is calculated as follows: 2 * (Access Slot # - 1)).

IEC/IEEE-bus command `:SOUR:W3GP:BMST3:SSCG 1`

TFCI STATE

ON The TFCI field is used in the frame.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:TFCI:STATE ON`

OFF The TFCI field is not used in the frame.

IEC/IEEE-bus command `:SOUR:W3GP:BMST2:TFCI:STATE OFF`

TFCI (DPCCH)

Setting the TFCI value in the range 0 to 63. A combination of 32 bits is selected with this value. This combination is distributed over 16 successive slots in groups of two.

IEC/IEEE-bus command `:SOUR:W3GP:BMST4:TFCI 21`

FBI STATE

OFF The FBI field is not used in the frame.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:FBI:MODE OFF`

1 BIT The FBI field is used in the frame and is 1 bit long.

IEC/IEEE-bus command `:SOUR:W3GP:BMST2:FBI:MODE BIT1`

2 BIT The FBI field is used in the frame and is 2 bits long.

IEC/IEEE-bus command `:SOUR:W3GP:BMST2:FBI:MODE BIT2`

FBI (DPCCH)

Selecting the data source for the FBI field.

ALL0 All 0s are continuously entered in the FBI field.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:FBI ZERO`

ALL1 All 1s are continuously entered in the FBI field.

IEC/IEEE-bus command `:SOUR:W3GP:BMST2:FBI ONE`

PATT The FBI field is cyclically filled with a pattern that is up to 16 bits long. A special pattern editor is displayed.

IEC/IEEE-bus commands

```
:SOUR:W3GP:BMST2:FBI PATT
:SOUR:W3GP:BMST2:FBI:PATT #ADAC
```

TPC (DPCCH)

Selection of data source for the TPC field.

ALL0 All 0s are continuously entered in the TPC field.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:TPC ZERO`

ALL1 All 1s are continuously entered in the TPC field.

IEC/IEEE-bus command `:SOUR:W3GP:BMST2:TPC ONE`

PATT The TPC field is cyclically filled with a pattern that is up to 16 bits long. Per slot, one bit is taken from this pattern and reduplicated, if necessary. A special pattern editor is displayed.

IEC/IEEE-bus commands

```
:SOUR:W3GP:BMST2:TPC PATT
:SOUR:W3GP:BMST2:TPC:PATT #ADAC
```

MISUSE TPC FOR OUTPUT POWER CONTROL

With W-CDMA, the TPC bits are used to signal increases or decreases in transmit power to the called station If this field is marked, the stated pattern is being misused to vary one's own transmit power over time. Per slot, one bit of this pattern is used to increase (bit = 1) or decrease (bit = 0) the channel power by the given power step **(POWER STEP TPC)**.
The upper limit is 0 dB and the lower –60 dB.
The following envelope occurs at a channel power of 0 dB, a power step of 1.0 dB and with a "001110100000011" pattern:

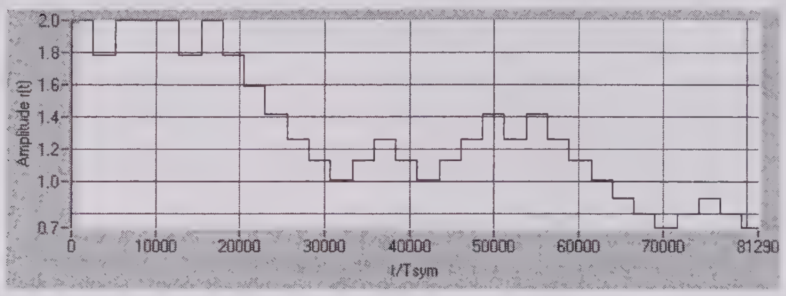


Fig. 2-110 Dynamic change of channel power

Note that the first bit is assigned to the first slot. In the first slot, the channel power is always taken from the table, ie the power change is skipped for the first slot.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:TPC:MIS ON`

POWER STEP

Power-step in dB, if the **MISUSE TPC FOR OUTPUT POWER CONTROL** option is active. The range is –10.0 dB to +10.0 dB.

IEC/IEEE-bus command `:SOUR:W3GP:BMST1:POW:STEP 1.0`

MULTI CHANNEL EDIT...

A certain number of DPCHs can be configured with just a few keystrokes thanks to this menu item. For further information see section 2.14.2.7.

CHANNEL GRAPH

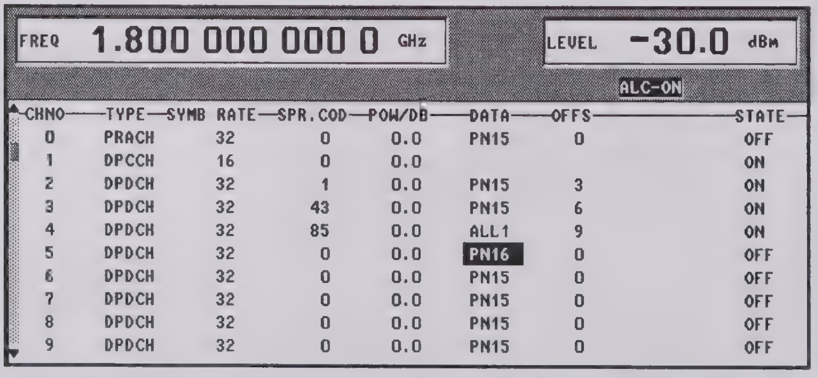
This menu item gives an overview of the assigned channels, see section 2.14.2.8.

CODE DOMAIN

This menu item indicates the assignment of code domain, see section 2.14.2.9.

Channel table:

Below the general parameters of the current base station, there is a table comprising all the parameters that can be edited on a channel-specific basis.



FREQ 1.800 000 000 0 GHz

LEVEL –30.0 dBm

ALC-ON

CHNO	TYPE	SYMB RATE	SPR.COD	POW/DB	DATA	OFFS	STATE
0	PRACH	32	0	0.0	PN15	0	OFF
1	DPCCH	16	0	0.0			ON
2	DPDCH	32	1	0.0	PN15	3	ON
3	DPDCH	32	43	0.0	PN15	6	ON
4	DPDCH	32	85	0.0	ALL1	9	ON
5	DPDCH	32	0	0.0	PN16	0	OFF
6	DPDCH	32	0	0.0	PN15	0	OFF
7	DPDCH	32	0	0.0	PN15	0	OFF
8	DPDCH	32	0	0.0	PN15	0	OFF
9	DPDCH	32	0	0.0	PN15	0	OFF

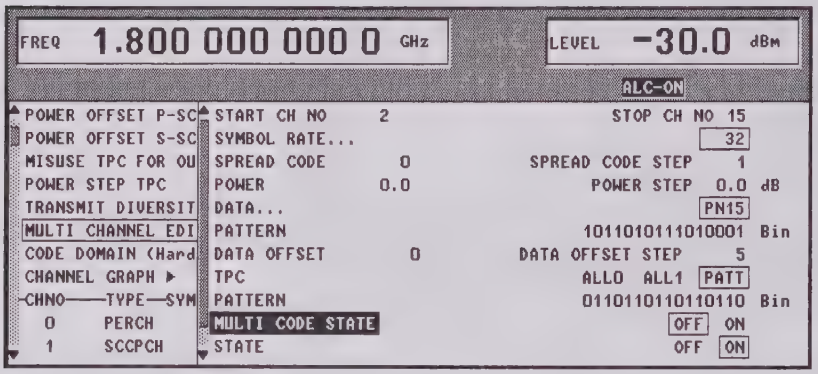
Fig. 2-111 DIGITAL STD - WCDMA/3GPP - MS CONFIGURATION / channel table menu

CH NO	Channel number, consecutive from 0 to 129. This value cannot be edited.
TYPE	Channel type which is permanently linked to the channel number and which cannot be edited: CH NO 0: PRACH (Physical Random Access Channel) CH NO 1: DPCCH (Dedicated Physical Control Channel) CH NO 2 to 129: DPDCH (Dedicated Physical Data Channel) Not all parameters in the table can be edited. This depends on the type of channel.
SYMBOL RATE	Symbol rate of the channel in ksym/s. The range depends on the type of channel. PRACH: 16k, 32k, 64k or 128k DPCCH: fixed at 16k DPDCH: 16k, 32k, 64k, 128k, 256k, 512k, 1024k (,2048k, 4096k) The two highest symbol rates are not specified in [1] but are still offered to provide compatibility with older standards. IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:SRAT 32K`
SPREAD CODE	Spreading code of channel. The DPCCH has a fixed spreading code of 0. The spreading codes for PRACH and DPDCHs can have values between 0 and a maximum value which depends on the chip rate and the symbol rate of the channel. These maximum values are listed in section 2.14.2.10. IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:SCOD 123`
POWER [DB]	Channel power in dB in the range –60 to 0.0 dB. The displayed power is relative to the other channels and initially does not refer to the LEVEL power display. After activating **ADJUST TOTAL POWER ▶** (top level of 3GPP W-CDMA menu) all power readings refer to LEVEL. IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:POW -10.0`
DATA	Selection of the data source for the DATA field. Select from PN9, PN11, PN15, PN16, ALL0, ALL1 and PATTern. How the PN generators operate is explained in section 2.12.3, for example. If PATTern data type is used, the pattern can be modified with a special editor. The length is limited to 16 digits. IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:DATA PN15` IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:DATA:PATT #H1234`
DATA OFFSET	Data offset in the range 0 to 40959 symbols. IEC/IEEE-bus command `:SOUR:W3GP:BMST3:CHAN3:DATA:OFFS 5`
STATE	ON The channel is active. All parameters in this row line are active. IEC/IEEE-bus command `:SOUR:W3GP:BMST1:CHAN1:STATE ON` OFF The channel is not active. All parameters in this row are ignored. IEC/IEEE-bus command `:SOUR:W3GP:BMST2:CHAN9:STATE OFF`

2.14.2.7 WCDMA/3GPP - Multi Channel Edit Menu

When MULTI CHANNEL EDIT is selected, a submenu in which several DPCHs can be configured is opened.

The following text first gives an explanation of the parameters in the downlink, then the differences between parameters in the uplink are described.



```
FREQ  1.800 000 000 0 GHz                     LEVEL  -30.0 dBm
                                                     ALC-ON
POWER OFFSET P-SC  START CH NO        2                STOP CH NO 15
POWER OFFSET S-SC  SYMBOL RATE...                             [32]
MISUSE TPC FOR OU  SPREAD CODE         0        SPREAD CODE STEP  1
POWER STEP TPC     POWER             0.0         POWER STEP  0.0 dB
TRANSMIT DIVERSIT  DATA...                                  [PN15]
[MULTI CHANNEL EDI] PATTERN                    1011010111010001 Bin
CODE DOMAIN (Hard  DATA OFFSET          0      DATA OFFSET STEP   5
CHANNEL GRAPH ▸    TPC                            ALL0  ALL1 [PATT]
-CHNO---TYPE---SYM PATTERN                     0110110110110110 Bin
  0     PERCH      MULTI CODE STATE                       [OFF]  ON
  1     SCCPCH     STATE                                   OFF  [ON]
```

Fig. 2-112 DIGITAL STD – WCDMA/3GPP – BS CONFIGURATION / MULTI CHANNEL EDIT menu

In this submenu, all parameters in the channel table can be set for a group of DPCHs. The parameter ranges are identical to those in the channel table.

MULTI CHANNEL EDIT...

START CH NO (DPCH)/ STOP CH NO (DPCH)

Range of DPCHs that are to be commonly configured. Range 2 to 129.

IEC/IEEE-bus `:SOUR:W3GP:MCH:STAR 2`
IEC/IEEE-bus `:SOUR:W3GP:MCH:STOP 129`

SYMBOL RATE

Symbol rate of DPCHs.

8k, 16k, 32k, 64k, 128k, 256k, 512k, 1024k, 2048k or 4096k.

IEC/IEEE-bus `:SOUR:W3GP:MCH:SRAT 64K`

SPREAD CODE NO / STEP

Spreading code for the first channel and step width for all other channels. The range is 0 to chiprate/8k.

IEC/IEEE-bus `:SOUR:W3GP:MCH:SCOD 4`
IEC/IEEE-bus `:SOUR:W3GP:MCH:SCOD:STEP 1`

POWER / dB
POWER STEP / dB

Channel power for the first channel (range -60 dB to 0 dB) and step width for all other channels (range -60 dB to 60 dB).

IEC/IEEE-bus `:SOUR:W3GP:MCH:POW -20`
IEC/IEEE-bus `:SOUR:W3GP:MCH:POW:STEP 1`

DATA

Selection of data pattern for the DPCHs. For other choices see channel table.

IEC-bus `:SOUR:W3GP:MCH:DATA PN9`
IEC-bus `:SOUR:W3GP:MCH:DATA:PATTERN #HFFFF`

(MULTI CHANNEL EDIT...)	**DATA OFFSET / DATA OFFSET STEP**	The number of symbols by which the first channel in the frame timing is to be offset relative to the sequence start. The step width of the data offset between two adjacent channels is defined with STEP. IEC/IEEE bus `:SOUR:W3GP:MCH:DATA:OFFS 0` IEC/IEEE bus `:SOUR:W3GP:MCH:DATA:OFFS:STEP 3`
	TPC	Data source for TPC field. IEC/IEEE-bus `:SOUR:W3GP:OUTP2:DEL 0`
	MULTI CODE STATE	ON The channels should be simulated with multicode. IEC/IEEE bus `:SOUR:W3GP:MCH:MCOD ON` OFF The channels should be simulated without multicode. IEC/IEEE bus `:SOUR:W3GP:MCH:MCOD OFF`
	STATE	ON The channels are active. IEC/IEEE bus `:SOUR:W3GP:MCH:STATE ON` OFF The channels are not active. IEC/IEEE bus `:SOUR:W3GP:MCH:STATE OFF`
	EXECUTE ▶	Number of chips by which the selected trigger output signal is delayed. IEC/IEEE-bus `:SOUR:W3GP:OUTP2:DEL 0`

The channel parameter ranges correspond to the associated parameters in the channel table (see above).
Start Channel No (DPCH)/Stop Channel No (DPCH): The range of the DPCHs that are to be set jointly is defined.

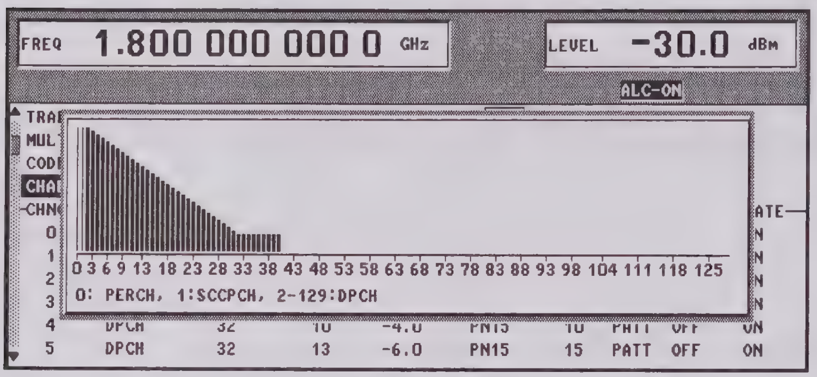
So that entire channel scenarios can be set up easily, start values and step widths can be entered for some parameters which are used to set the channel parameters. **Spreading code** and **spreading code step** parameters, for example, can be used to create simple scenarios in which spreading codes with a fixed step width are assigned to the various code channels. Power profiles (via the code axis) can be created in the same way with **power** and **power step**. The **data offset** and **data offset step** parameters can be used to change the relative slot timings of the channels, so changing the crest factor of the signal (see also section 2.14.3.3).

In the uplink, the menu has basically the same settings, even the IEC/IEEE-bus commands are identical. The differences are as follows:

- The designation “DPCH” is replaced by “DPDCH”
- The symbol rate 8k is omitted
- The parameters TPC and MULTI CODE STATE are omitted.

2.14.2.8 WCDMA/3GPP Menu – Display of Channel Graph

The channel graph provides an overview of the contents of the channel table. Consequently, only current BS/MS channels are indicated.



FREQ 1.800 000 000 0 GHz

LEVEL -30.0 dBm

ALC-ON

0: PERCH, 1:SCCPCH, 2-129:DPCH

5 DPCH 32 13 -6.0 PN15 15 PATT OFF ON

Fig. 2-113 DIGITAL STD – WCDMA/3GPP – BS CONFIGURATION /CHANNEL GRAPH menu

All active channels and their channel powers are displayed. Unlike the code domain display (next chapter), all channels are shown with the same width. Multiple assignment of a code domain range cannot be seen.

2.14.2.9 WCDMA/3GPP Menu – Display of Code Domain and Code Domain Conflicts

The spreading codes are taken from a code tree (see below).
The greater the spreading factor, the smaller the symbol rate and vice versa. The product of the spreading factor and the symbol rate is constant and always equals the current chip rate.
The outer branches of the tree (right-most position in the figure) give the spreading codes for the lowest symbol rate (and so the highest spreading factor). The use of a spreading code from the level with a spreading factor N blocks the use of all other spreading codes from levels with spreading factor >N in the same branch of the code tree. Spreading codes with a smaller spreading factor are contained in the codes with larger spreading factor in the same code branch. If spreading codes of this type were used at the same time, the signals of associated code channels would be mixed up to such an extent that they could not be separated in the receiver; orthogonality would be lost.

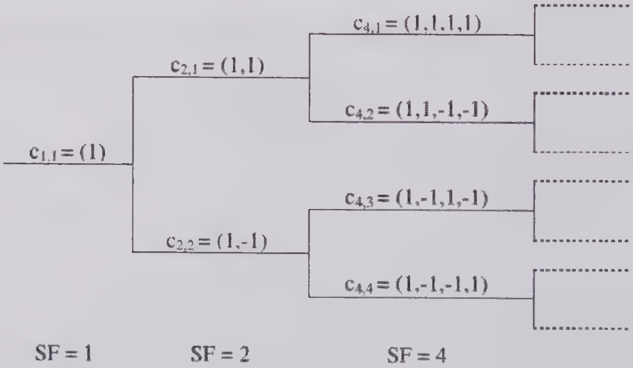


Fig. 2-114 Code tree of spreading codes

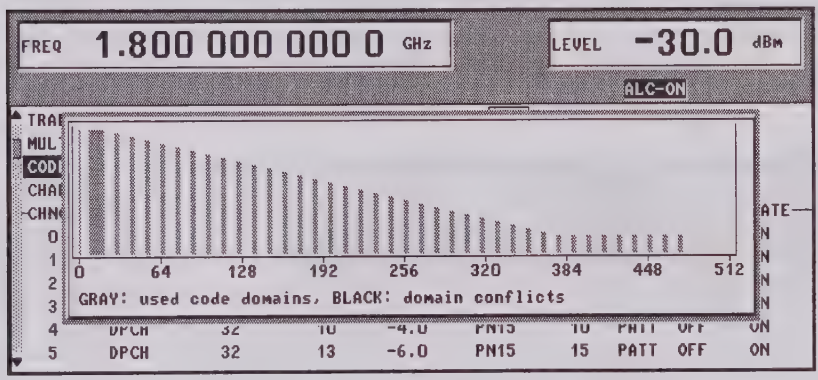
Example: If in Fig. 2-114 code $c_{2,1}$ is already used, the remaining branch is blocked with $c_{4,1}$ and $c_{4,2}$.

In the sequel, the outer branch region (with minimum symbol rate and max. spreading factor) which is based on the spreading code selected in the code tree is defined as the **domain** of a certain spreading code. Using a spreading code means that its entire domain is used. The whole domain depends on the chip rate:

Table 2-24 Size of code domain as a function of chip rate

Chip rate	Domain
3.84 MChips/s	0 to 511
4.096 MChips/s	0 to 511
8.192 MChips/s	0 to 1023
16.384 MChips/s	0 to 2047

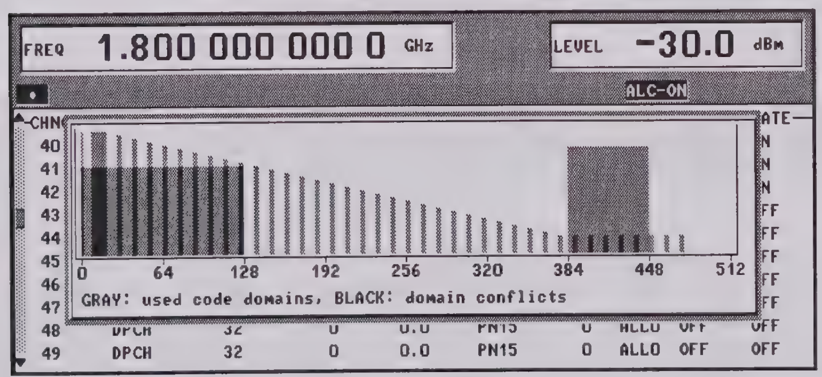
A graphic is displayed with the **CODE DOMAIN** menu item or the **STATUS** hardkey. This graphic shows the occupancy of the code domain by the active code channels.



5 DPCH 32 13 -6.0 PN15 15 PATT OFF ON

Fig. 2-115 WCDMA/3GPP – BS CONFIGURATION / CODE DOMAIN menu (without conflict)

This display shows at a glance whether assigned code domains of various channels overlap, ie whether a domain conflict occurs. The symbol rates of code channels are indicated by the width of the associated bars. The height of the bars gives the power of the code channel. If a bar is grey, the code domain at this position is assigned once. A conflict does not occur. If a bar is black (at least partly), the code domain is assigned at least twice. A conflict occurs.



49 DPCH 32 0 0.0 PN15 0 ALLO OFF OFF

Fig. 2-116 WCDMA/3GPP – BS CONFIGURATION / CODE DOMAIN menu (with conflict)

Display of domain conflicts
If a domain conflict occurs in the base station/mobile station, this conflict is displayed at two locations (next to the code domain display).

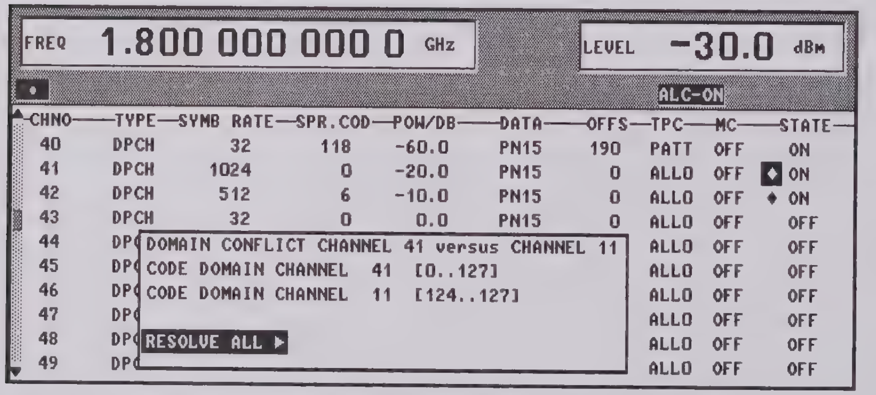
1. Centrally for the whole station in the status line ●,
2. All lines in the channel table (processed in ascending channel numbers) showing a domain conflict in a row with a lower index are indicated with a warning symbol ♦ to the left of STATE.

A domain conflict occurs when the assigned domains of different channel rows overlap. The assigned code domain of a channel is calculated from the symbol rate of the channel, the minimum possible symbol rate (depending on the link direction), the chip rate and the spreading code number using the following equation:

$\mathbf{Domain\_factor} = \dfrac{\mathbf{current\_symbolrate}}{\mathbf{minimum\_symbolrate}}$ (the minimum symbol rate is 8 ksym/s in downlink), where:

Lower domain limit = current spreading code number * domain factor
Upper domain limit = lower domain limit + domain_factor –1.

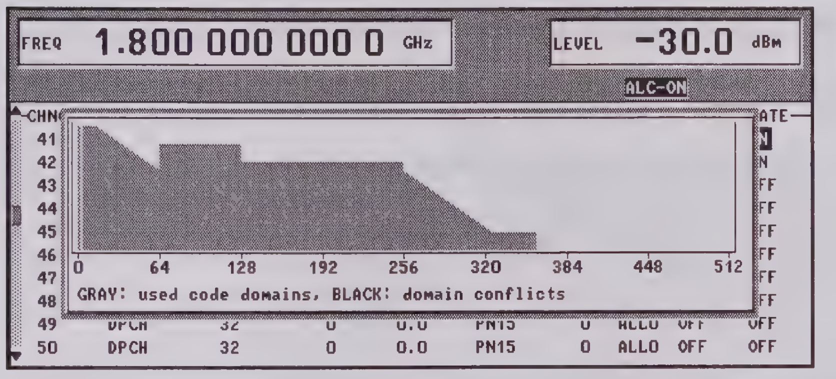
If the cursor is positioned on one of the warning symbols ♦ and if the SELECT button is clicked, a window is opened and shows more accurate information about the domain conflict that has occurred. The numbers of channel rows in the channel table and the assigned domains of the conflicting channels are displayed.



```
FREQ   1.800 000 000 0  GHz                    LEVEL   -30.0  dBm
 ●                                                       ALC-ON
CHNO---TYPE--SYMB RATE--SPR.COD--POW/DB----DATA----OFFS--TPC---MC----STATE-
 40    DPCH       32       118    -60.0    PN15     190  PATT  OFF    ON
 41    DPCH     1024         0    -20.0    PN15       0  ALLO  OFF  ◆ ON
 42    DPCH      512         6    -10.0    PN15       0  ALLO  OFF  ♦ ON
 43    DPCH       32         0      0.0    PN15       0  ALLO  OFF    OFF
 44    DP DOMAIN CONFLICT CHANNEL 41 versus CHANNEL 11   ALLO  OFF    OFF
 45    DP CODE DOMAIN CHANNEL  41  [0..127]              ALLO  OFF    OFF
 46    DP CODE DOMAIN CHANNEL  11  [124..127]            ALLO  OFF    OFF
 47    DP                                                ALLO  OFF    OFF
 48    DP RESOLVE ALL ▶                                  ALLO  OFF    OFF
 49    DP                                                ALLO  OFF    OFF
```

Fig. 2-117 WCDMA/3GPP – BS CONFIGURATION / CODE DOMAIN CONFLICT menu

Resolve all Conflicts
If you select the **RESOLVE ALL** button in the domain conflict info window, the SMIQ tries to arrange the active code channels so that no overlapping in the code domain occurs. The spreading code number of the channels is varied to do this. The effect of a conflict resolution is shown by the code domain display.



FREQ 1.800 000 000 0 GHz

LEVEL -30.0 dBm

GRAY: used code domains, BLACK: domain conflicts

```
50   DPCH   32   0   0.0   PN15   0  ALLO  OFF   OFF
```

Fig. 2-118 WCDMA/3GPP – BS CONFIGURATION / CODE DOMAIN menu (after conflict resolution)

If the assigned domain of all active channels is greater than the physically available domain (eg 3 channels with 2.048 ksym/s at a chip rate of 4.096 Mchips/s), conflicts can no longer be resolved. The message "no resolution of domain conflicts possible" is displayed.

2.14.2.10 Maximum Values for Spreading Code

Downlink

Table 2-25 Possible symbol rates and spreading codes (downlink)

3.84 and 4.096 MC/s	8.192 MC/s	16.384 MC/s	(Chip/symbol) =spreading factor	Maximum value for spreading code
Physical channel Symbol rate kS/s				
4096			1	0
2048	4096		2	1
1024	2048	4096	4	3
512	1024	2048	8	7
256	512	1024	16	15
128	256	512	32	31
64	128	256	64	63
32	64	128	128	127
16	32	64	256	255, only 0 for PERCH
8	16	32	512	511, only 0 for PERCH
	8	16	1024	1023, only 0 for PERCH
		8	2048	2047

Uplink

Table 2-26 Possible symbol rates and spreading codes (uplink)

3.84 and 4.096 MC/s	8.192 MC/s	16.384 MC/s	(Chip/symbol) =spreading factor	Maximum value for spreading code
Physical channel Symbol rate kS/s				
4096			1	0
2048	4096		2	1
1024	2048	4096	4	3
512	1024	2048	8	7
256	512	1024	16	15
128	256	512	32	31
64	128	256	64	63
32	64	128	128	127
16	32	64	256	255, only 0 for PERCH
	16	32	512	511, only 0 for PERCH
		16	1024	1023, only 0 for PERCH

2.14.2.11 Effect of T SECTOR and Data Offset on the Signal

When considering the effects of T SECTOR and the data offset, four cases can be distinguished:

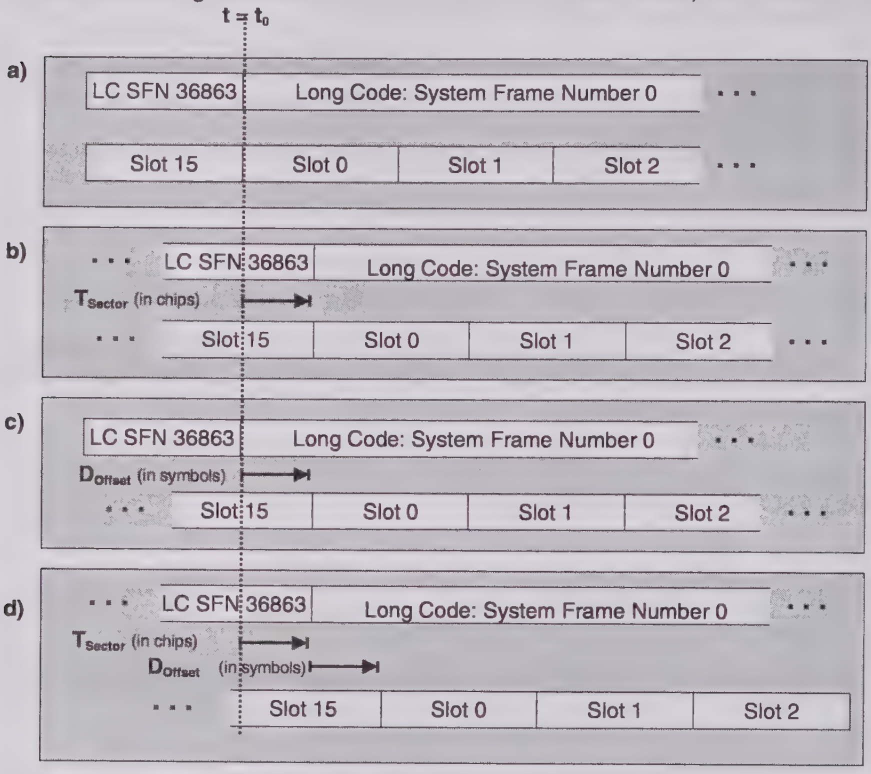


Fig. 2-119 Effect of T_{Sect} and data offset

The above figure shows the effect of the parameters T Sector and data offset. T SECTOR can be globally set for the base station and data offset for each code channel. For a variety of scenarios, the long code sequence is shown time referenced to the data slots and to a reference time t_0 (the signal is calculated and output from t_0 by the SMIQ).

a) T SECTOR and data offset are not used (all = 0). The beginning of the frame (slot 0) and the beginning of the long code period (with system frame number 0) are synchronous with the starting time t_0.

b) T SECTOR is used, but data offset is not. Both the absolute starting point of the long code sequence and the data slots are shifted relative to the reference time t_0 by TSECTOR chips. The beginning of the frame (slot 0) and the beginning of the long code period (with system frame number 0) are synchronous.

c) Data offset is used, but T SECTOR is not. The absolute starting time of the frames (slot 0) is shifted relative to the reference time t_0 by D_{Offset} symbols. The beginning of the long code sequence is still the reference time t_0. The beginning of the long code period (with system frame number 0) and the frame (slot 0) no longer coincide.

d) T SECTOR and data offset are both used. The beginning of the long code sequence is shifted relative to the reference time t_0 by T SECTOR chips. The absolute starting time of the frames (slot 0) is shifted relative to the reference time t_0 by T SECTOR chips + D_{Offset} symbols. The beginning of the long code period (with system frame number 0) and the frame (slot 0) no longer coincide.

The purpose of these parameters is described in section 2.14.1, their effect on the signal, in section 2.14.3.

2.14.2.12 Effect of CLIPPING LEVEL Parameter on Signal

W-CDMA signals may have very high crest factors - especially if the number of channels is high and the data offset is unfavourable (see sections 2.14.3.2 and 2.14.3.3). High crest factors cause two main problems:

1. The nonlinearity of the power amplifiers (compression) causes intermodulation and so a spectral regrowth
2. Since the modulation of the D/A converters is oriented towards the maximum value, the average value is converted at a relatively small resolution. The resuls is high quantization noise.

Both effects cause higher adjacent channel power.

Among the ways of influencing the crest factor listed in section 2.14.3.3, modification of the CLIPPING LEVEL is the most effective and straightforward. A limit which is a percentage of the highest peak value is defined.
All instantaneous values that are higher than this limit are reduced to this limit. Since this process is performed prior to filtering, it does not affect the spectrum. The EMC value does go up however.

As limiting the signal changes the average value as well as the peak value, the effect on the crest factor is not immediately obvious. The following table shows the effect of the CLIPPING LEVEL on the crest factor for some typical scenarios.

CLIPPING LEVEL	Crest factor for scenario			
	Downlink : 10 DPCHs "minimum crest" 32ksps	Downlink : 10 DPCHs "worst crest" 32 ksps	Downlink : 10 DPCHs "average crest" 32 ksps	Downlink : 128 DPCHs "average crest" 32 ksps
100%	9.89 dB	14.7 dB	10.9 dB	21.7 dB
80%	8.86 dB	12.9 dB	9.39 dB	20.2 dB
50%	7.50 dB	10.1 dB	8.29 dB	16.9 dB
20%	5.50 dB	6.47 dB	6.23 dB	12.5 dB
10%	5.34 dB	6.06 dB	5.80 dB	9.57 dB
5%	5.34 dB	6.06 dB	5.80 dB	8.17 dB

2.14.2.13 Synchronization and Trigger Signals

To generate the W-CDMA signals, a chip sequence is calculated and stored in the waveform memory of the modulation coder (option SMIQB20). This chip sequence is automatically repeated (TRIGGER MODE AUTO).
For measurements on receivers, trigger signals can also be used for synchronized sequences (TRIGGER MODE RETRIG, ARMED_AUTO or ARMED_RETRIG).

The trigger signal is applied to the TRIGIN input of the PAR DATA connector. The chip sequence either starts immediately after the active edge of this trigger signal or after a settable number of chips (EXT TRIGGER DELAY). A retrigger (RETRIG) can be inhibited for a settable number of chips (EXT RETRIGGER INHIBIT).

A trigger event can be triggered manually with EXECUTE TRIGGER or via the IEC/IEEE bus. A trigger signal is always output at TRIGOUT 3 output of the SMIQ at the same time as a trigger event.

The SMIQ generates the following sync signals:

- a 0.625 ms slot-clock
- a 10 ms radio-frame clock
- a marker signal to identify the periodic repetition of the generated chip sequence

SMIQ can output a selection of two or three signals via connectors TRIGOUT 1 and 2 of the PAR DATA connector.

The chip clock in the SMIQ is generated by a clock synthesizer in the modulation coder. All clock signals are in sync with the unit's 10 MHz reference. The chip clock is available at the SYMBOL CLOCK connector. If required, the clock synthesizer in the SMIQ can use an external chip clock which is fed in via the SYMBOL CLOCK connector .

To ensure reliable clock-synthesizer synchronization, the external clock must first be applied and the correct SMIQ chip rate set (MODULATION – CHIPRATE VARIATION). The CLOCK SOURCE can then be switched from INT to EXT.

Note: *The set chip rate may not differ by more than 1% from the chip rate of the external signal.*

2.14.2.14 Preset/Default Values

The following settings are made if the menu item SET DEFAULT is selected or if the PRESET key is pressed during switch-on.

General default settings

CHIP RATE	4.096 Mcps
LINK	DOWN/FORWARD
3GPP VERSION	2.1.0
MODULATION	WCDMA filter, roll-off 0.22, LOW ACP, chip rate of 4.096 Mcps
TRIGGER	
MODE	RETRIG
SOURCE	INT
DELAY	0
INHIBIT	0
OUT 1	RADIO FRAME
OUT 2	CHIP SEQUENCE PERIOD
OUT1/2 POL	POS
OUT ½ DELAY	0
CLOCK SOURCE	INT
CLOCK DELAY	0.00
SEQUENCE LENGTH	1

Default settings for DOWN/FORWARD link

Para. Predef. Settings

PERCH	ON
SCCPCH	ON to 64k
NO OF DPCH	3
SYMBOL RATE	32 ksym/s
CREST	MINIMUM

Base station parameters

Table 2-27 Default values for base station parameters

Parameters	BS1	BS2	BS3	BS4
STATE	ON	OFF	OFF	OFF
LONG CODE INIT	0x1000	0x2000	0x3000	0x4000
T SECTOR	0	0	0	0
USE TFCI	OFF	OFF	OFF	OFF
TFCI	0	0	0	0
2nd SEARCH CODE GR.	1	2	3	4
Power Offset P-SCH	0	0	0	0
Power Offset S-SCH	0	0	0	0
Misuse TPC...	OFF	OFF	OFF	OFF
Power Step	0	0	0	0
Transmit Diversity	OFF	OFF	OFF	OFF

Multi Channel Edit

START DPCH	2
STOP DPCH	2
SYMBOL RATE	32 ksym/s
SPREAD. CODE	0
SPREAD. STEP	0
POWER	0dB
POWER STEP	0dB
DATA	PN 15
DATA OFFSET	0
DATA OFFSET STEP	0
TPC	ALL 0 (0)
MULTI CODE STATE	OFF
STATE	ON

Channel table parameters

Common for all channels of all base stations:

POWER	0 dB
DATA	PN15
TPC	ALL0 (0)
MC STATE	OFF
DATA PATTERN	"0000 0000 0000 0000"
TPC PATTERN	"0000 0000 0000 0000"

Symbol rates

for all PERCHs	16 ksym/s
for all SCCPCHs	64 ksym/s
for all DPCHs	32 ksym/s

STATE: ON for channel 0 to 4 BS 1, otherwise OFF

Table 2-28 Default values for **channel table** (downlink)

(Para. Predef. with PERCH ON, SCCPCH ON, NO OF DPCH 3, SYMBOL RATE 32 ksym/s, CREST MINIMUM)	SPREAD. CODE	DATA OFFSET	STATE
CH 0 MS1 (PERCH)	0	0	ON
CH 1 MS1 (SCCPCH)	1	3 (preliminary)	ON
CH 2 MS1 (DPCH)	4	6 (preliminary)	ON
CH 3 MS1 (DPCH)	45	9 (preliminary)	ON
CH 4 MS1 (DPCH)	86	12 (preliminary)	ON
Miscellaneous	0	0	OFF

Default settings for UP/REVERSE link

Para. Predef. Settings

PRACH	OFF
DPCCH	ON
NO OF DPDCH	3
SYMBOL RATE	32 ksym/s
CREST	MINIMUM

Multi Channel Edit

START DPDCH	2
STOP DPDCH	2
SYMBOL RATE	32 ksym/s
SPREAD. CODE	0
SPREAD. STEP	0
POWER	0dB
POWER STEP	0dB
DATA	PN 15
DATA OFFSET	0
DATA OFFSET STEP	0
STATE	ON

Mobile station parameters

Table 2-29 Default values for mobile station parameters

Parameters	MS1	MS2	MS3	MS4
STATE	ON	OFF	OFF	OFF
LONG CODE INIT	0x1000	0x2000	0x3000	0x4000
T SECTOR	0	0	0	0
SIGNATURE	0	0	0	0
ACCESS SLOT	1	1	1	1
USE TFCI	OFF	OFF	OFF	OFF
TFCI	0	0	0	0
USE FBI	OFF	OFF	OFF	OFF
FBI	ALL0	ALL0	ALL0	ALL0
TPC	ALL0	ALL0	ALL0	ALL0
Misuse TPC...	OFF	OFF	OFF	OFF
Power Step	0	0	0	0

Channel-table parameters

Common for all channels of all base stations:

POWER	0 dB
DATA	PN15
DATA PATTERN	"0000 0000 0000 0000"

Symbol rates

For all PRACHss	32 ksym/s
For all DPCCHs	16 ksym/s
For all DPDCHs	32 ksym/s

Table 2-30 Default values for channel table (uplink)

(Para. Predef. with: PRACH OFF, DPCCH ON, NO OF DPDCH 3, SYMBOL RATE 32 ksym/s CREST MINIMUM)	SPREAD. CODE	DATA OFFSET	STATE
CH 0 MS1 (PRACH)	0	0	OFF
CH 1 MS1 (DPCCH)	0	0 (preliminary)	ON
CH 2 MS1 (DPDCH)	1	3 (preliminary)	ON
CH 3 MS1 (DPDCH)	43	6 (preliminary)	ON
CH 4 MS1 (DPDCH)	85	9 (preliminary)	ON
Miscellaneous	0	0	OFF

2.14.3 Further Information on the Generation of 3GPP W-CDMA Signals

This section provides some background information on 3 GPP W-CDMA signals to help the user generate signals with particular characteristics.

2.14.3.1 3GPP W-CDMA Signals in the Time and Frequency Domain

2.14.3.1.1 Time Domain (Baseband)

Downlink

The two spreading methods for SCH and the remaining (downlink) channel types are explained for the PERCH. A (downlink) signal that only contains the PERCH at 0 dB is generated. The SCH components are generated with double amplitude for better distinction against PCCPCH. At this purpose, the values POWER OFFSET P-SCH and POWER OFFSET S-SCH have to be set to +6 dB.

Further settings:

Sequence length	*1*
Chip rate	*4.096 Mcps*
Filtering	*Root cosine (roll off = 0.22)*
Data source	*PRBS23*

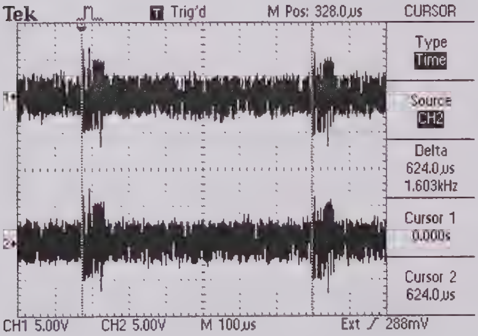


Fig. 2-120 Signal of perch channel (channel 1:I, channel 2:Q) in time domain

The first thing that you will see is that a time slot is 625 µs in duration. You will also notice that the power is higher with the first 10% of the signal. This is the SCH. Zooming in on this transition point reveals the following:

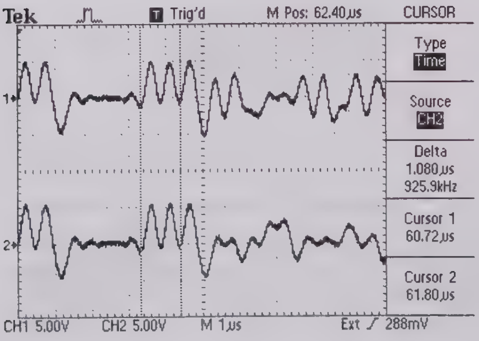


Fig. 2-121 Perch channel signal in the time domain (zoomed)

The right section (ie the 9 PCCPCH symbols) is spread as described in Fig. 2-122. You can see that for each symbol clock, one of the two components is 0 and the other one ±2 (a certain inaccuracy is due to the root cosine filter used).

This is the standard spreading scheme which is also used for SCCPCH and DPCH.

The left section (the synchronization code symbol occupying the chip range 0 to 255) is obtained using special synchronization code spreading: In this case, no long code is used, ie there is no scrambling unit ($S_i = C_i$, $S_q = C_q$). Since the synchronization code symbol is defined as 11, the following is always true:

$S_i = S_q$.

The result is a BPSK mapping turned by 45° relative to the QPSK constellation of the SCCPCH component.

Since the synchronization code symbol is sent twice (in the primary and secondary SCH) with different spreading, the signal power is doubled in this range.

The constellation diagram of the perch channel, therefore, has the following appearance:

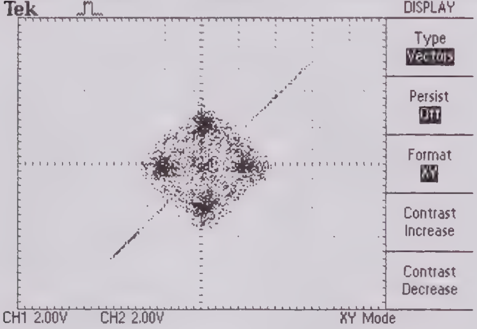


Fig. 2-122 Constellation diagram of perch channel

The four circular areas are due to PCCPCH ("QPSK"), the linear areas (diagonal) to SCH ("BPSK").

Note: *The large amount of smearing around the actual constellation points is caused by the root cosine filter and the high oversampling of the digital oscilloscope. If suitable receive filters are used, these areas are much sharper, as is shown in section 2.14.3.2.3.*

The spreading scheme for the SCH symbols can also be used for the PRACH preamble. In this case too, the I and Q paths here are fed with identical data and the scrambling unit is omitted. The BPSK constellation diagram is also produced.

The spreading/constellation diagrams of the SCCPCH and the DPCH are identical to the spreading/constellation diagram of the PCCPCH.

Uplink

In the uplink, for the DPDCH/DPCCH, the data are supplied either to the I path or to the Q path. The second path is not used (second path is: $C_q = 0$).

as

$$S_i = C_i LC_i - C_q LC_q'$$
$$S_q = C_i LC_q' + C_q LC_i$$

the following equations are obtained:

$$S_i = C_i LC_i$$
$$S_q = C_i LC_q'$$

This corresponds to a QPSK constellation diagram, but rotated with respect to the DPCH constellation diagram:

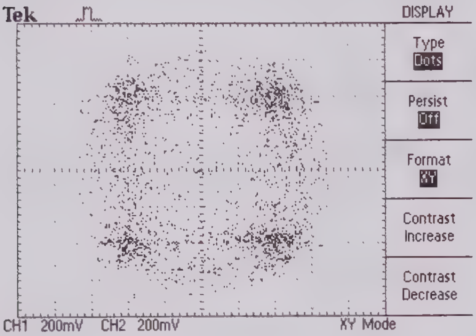


Fig. 2-123 Constellation diagram of a DPDCH/DPCCH

The PRACH comprises a preamble and a message part. The preamble is spread like the SCH, the message part like a DPCH.

2.14.3.1.2 Frequency Range

The spectrum of a 3GPP W-CDMA signal (a DPCH channel) is the same as that of a QPSK signal with identical filter parameters.

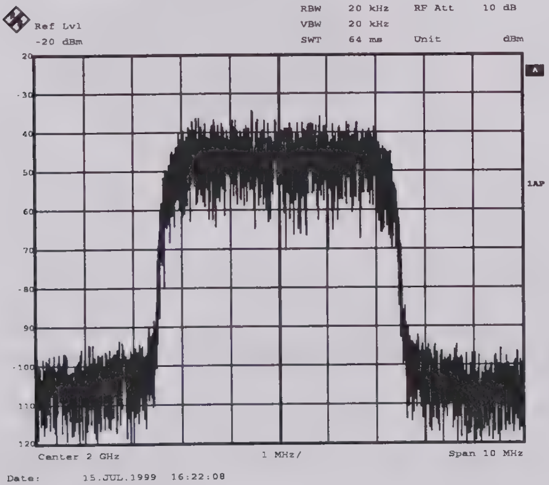


Fig. 2-124 Magnitude spectrum (section) of a 3GPP W-CDMA signal

If signals with several channels are investigated, a certain amount of ripple may occur in the range between +/-0.5 of the chip rate.

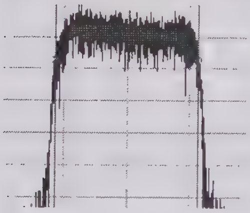


Fig. 2-125 Magnitude spectrum (section) of a 3GPP W-CDMA signal with several channels

This effect is sensitive to the choice of spreading code and becomes less noticable as the period of observation increases, ie higher averaging for the FFT settings.

2.14.3.2 Effect of the Data Source on the 3GPP W-CDMA Signal

The choice of data sources is of crucial importance for the signal characteristics. The constellation diagram in particular and the crest factor can be modelled over a wide range if appropriate data is selected.

As the number of channels can be very large, particularly in the downlink, section 2.14.3.2 deals only with the simulation of downlink signals.
In the following, it is assumed that all channels are generated with the same long code sequences (standard base-station scenario see section 2.14.3.5.1) and the same channel power of 0.0 dB. A symbol rate of 64 ksps is selected at a chip rate of 4.096 Mcps.

2.14.3.2.1 Two DPCHs with Uncorrelated Data

If the two channels are uncorrelated (eg PN15 data source), the constellation diagram is obtained by superposing the constellation diagrams of two separate signals (see Fig. 2-126).

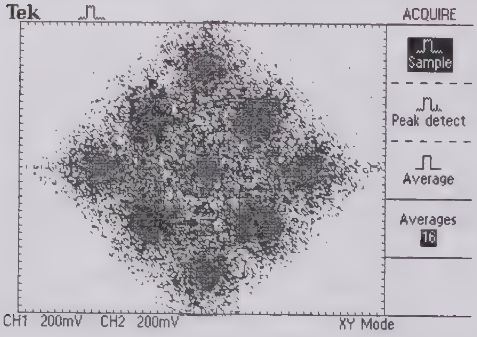


Fig. 2-126 Constellation diagram of a signal with two DPCHs (uncorrelated data)

The resulting crest factor is 8.07 dB.

2.14.3.2.2 Two DPCHs with the Same Data

If the two channels contain exactly the same data (e.g. ALL0 data source), the only difference between the individual components is the spreading codes. Comparing any two rows of the spreading code matrix shows that 50% of the bits are identical and 50% are different (orthogonality).
Where the bits are identical, both channels have the same components, where the bits are different, the components cancel out. The I/Q signal of this sum signal might then be displayed as follows:

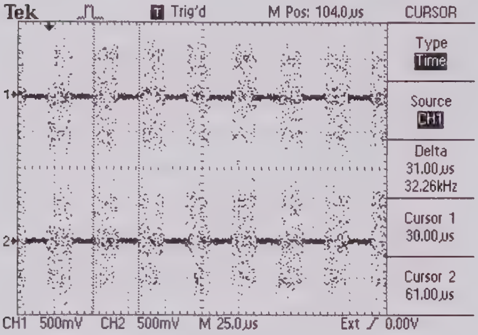


Fig. 2-127 Signal of two DPCHs (same data) in time domain

The symbol duration of 31µs, which corresponds to a symbol rate 32 ksym/s, can be read off between the cursor lines.

Note: *The regularity of the bursts is due to the use of the spreading code numbers 0 and 1. The two rows of the matrix are identical in the first half and different in the second. Therefore, each of the 40 source symbols causes one of these bursts. The duration of each burst is equal to half the symbol length. Other combinations of spreading code numbers often cause less regular bursts.*

The following constellation diagram is obtained:

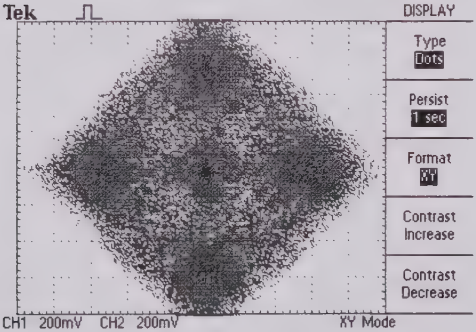


Fig. 2-128 Constellation diagram of a signal with two DPCHs (uncorrelated data)

The new crest factor is 7.64 dB. Compared to section 2.14.3.2.1, the value has decreased, as the average value has increased and the peak value was constant.

2.14.3.2.3 16 DPCHs with Uncorrelated Data

If the data in all channels are uncorrelated, the constellation diagram is obtained in the same way as in section 2.14.3.2.1 ie, by multiple superposition. Whether all possible points $(\text{channel number}+1)^2 = 17*17 = 289$ will be displayed depends on the data sequences and the sequence length.

Note: *Unlike the previous constellation diagrams, all further diagrams were recorded with active receiver filter (root cosine 0.22). This makes it easier to discriminate between points.*

Example for 16 time slots:

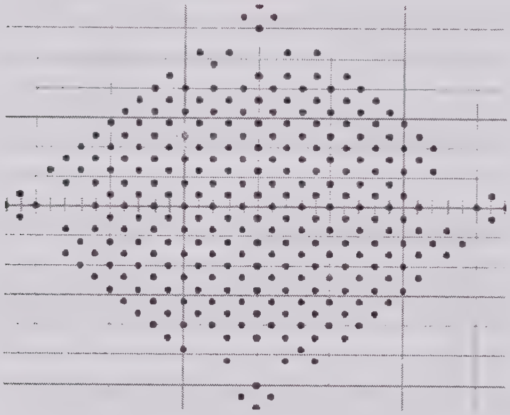


Fig. 2-129 Constellation diagram of 16 uncorrelated channels (16 time slots)

This signal has a crest factor of 15.35 dB. The crest factor increases with the number of channels since the average value increases more slowly than the peak value (cancelling effects).

The same diagram for a signal with only one slot is obtained:

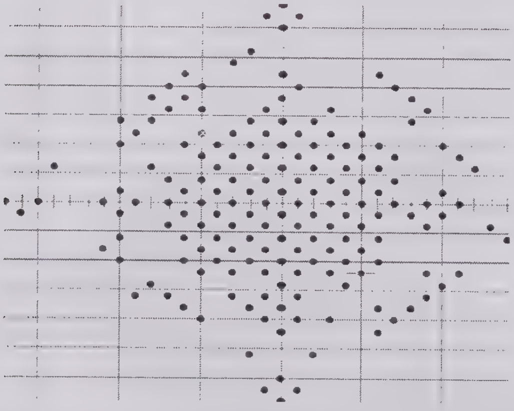


Fig. 2-130 Constellation diagram of 16 uncorrelated channels (1 time slot)

The crest factor is still 15.35 dB even though the CDF has a different characteristic.

2.14.3.2.4 16 DPCHs with Same Data

As in section 2.14.3.2.2, there are strong cancellations and only points remain on the axes. The position of the points also depends on the choice of spreading codes. The following diagram is an example based on 16 channels, spreading code 0 to 15:

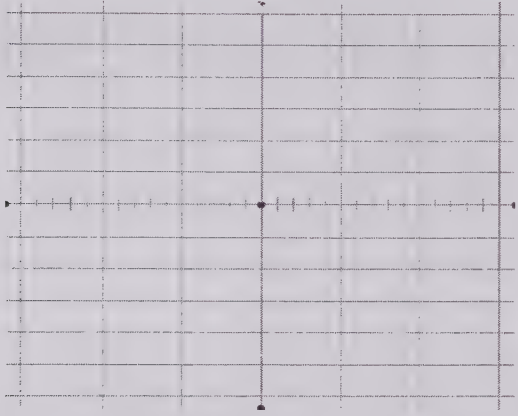


Fig. 2-131 Constellation diagram of 16 DPCHs with same data

In this case, the crest factor is 16.04 dB. This value is so high because about 94 % of the points are at the origin and just 6% elsewhere.

2.14.3.2.5 Use of Data Offsets

All previous scenarios did not use a data offset. Therefore, all channels contained the same bits - at least in the pilot symbol part. The result of this special condition was that the 4 corner points (0, 2*number of channels), (0, -2*number of channels), (2*number of channels, 0), (-2*number of channels, 0) where always present (constructive superposition).
By using a data offset (in our example 7 symbols from channel to channel), the data bits (including pilot and TPC) are shifted relative to each other.
This worst case is therefore eliminated, the crest factor becomes smaller and the spread symbols are arranged as follows:

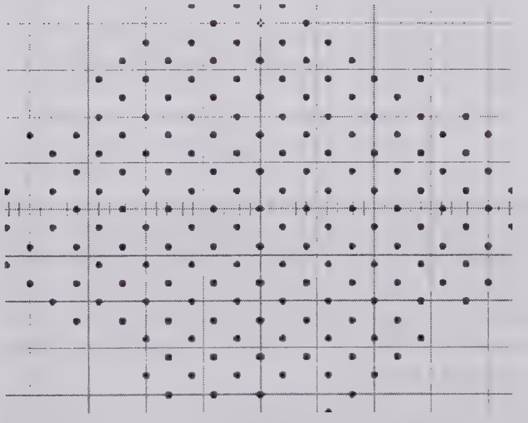


Fig. 2-132 Constellation diagram of 16 DPCHs with data offset

By using the data offset, the crest factor was reduced by approx. 3 dB to 12.52 dB.
The effect of the data offset increases with the number of channels. If, say, 64 channels are used, the crest factor is reduced from 18.36 dB to 11.24 dB.

2.14.3.3 Effects on the Crest Factor

The crest factor of the signal is influenced by the following parameters in particular:

- Link direction

  By modifying the Q component of the long code in the uplink, it is possible to avoid every second zero crossing (1 DPDCH). In contrast to the downlink, the crest factor is reduced by approx. 1.7 dB. The effect decreases as the number of channels increases.

- Data offset (see section 2.14.3.2.5)
  Do not select a value that is a divisor of the length of a time slot. The value should also be greater than the length of pilot (+TPC) if only a few channels are active.
- Sequence length if data offset is active
  Longer sequences cause higher peak values and so higher crest factors as the probability of even higher peak values increases.
- Number of channels
  A higher number of channels causes higher crest factors.
- Selection of spreading codes
  Neighbouring spreading code numbers usually cause higher crest factors than numbers distributed over the full range of available values.

  Example: 16 channels with spreading code numbers 0 to15: 16.7 dB
  16 channels with spreading code numbers 0, 4, 8, to 60: 12.45 dB
- Value of clipping level (see section 2.14.2.12)
  By limiting the signal, the crest factor can be reduced to almost any small value.

2.14.3.4 Orthogonality of Channels

If a 3GPP W-CDMA demodulator is to be able to recover the information in particular channels from the sum signal, only certain combinations of

- long code sequences,
- channel power and
- symbol rate and spreading codes

are possible.

2.14.3.4.1 Ideal Scenario

In an ideal scenario, the measured channel power (eg with code domain power analyzers) is exactly equal to the transmitted power (setting value in the channel configuration table), Even with great differences between the channel powers, 100% of the channel information can be recovered. Channel orthogonality is, however, a necessary condition for 100% recovery. Orthogonality is described in section 2.14.3.2. Orthogonality occurs, for example, if only DPCH channels are used and all of them have the same symbol rate but different spreading code numbers. Furthermore, identical long code initial values have to be set for all channels, ie all channels must belong to a base station.

In this case, the bit streams LC_i and LC_q' are identical for all channels. As the spreading code sequences of two channels are orthogonal, the chip sequences S_i and S_q of two channels are also orthogonal.

2.14.3.4.2 Real Scenario

A real scenario usually involves a signal mix from different base/mobile stations that are operated using different long codes and have different delays.

In this case, there is no orthogonality. The channel powers overlap and bit error rates increase with decreasing channel power (therefore power control is extremely important for all CDMA systems.

2.14.3.4.3 Effect of the Perch Channel

The perch channel is not orthogonal to the DPCHs since the synchronization code symbol is spread according to a special scheme (see section 2.14.1, "System Components").

If, say, two DPCHs (64 ksps, spreading code numbers 1 and 2) and the perch channel are coded at 0 dB, the following level conditions will be obtained after despreading:

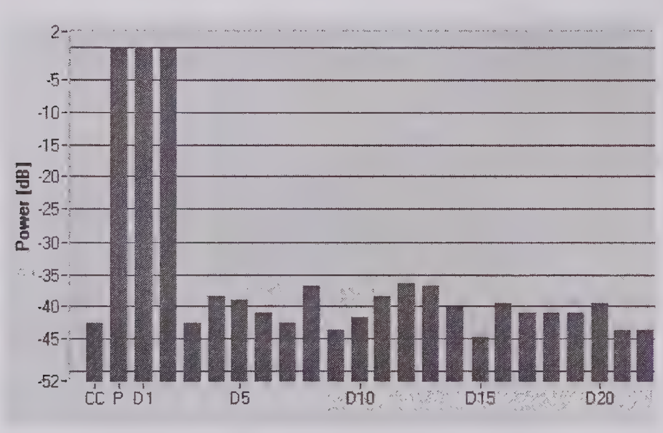


Fig. 2-133 Effect of perch channel on power distribution

The three transmitted channels are measured with an error of <0.2 dB. For all other channels, a power of approx. -40 dB is found.
These conditions still allow error-free decoding of all transmitted channels.

If the perch channel is used, the spreading code number 0 should be avoided for CPCH/DPCH channels since the last part of the perch channel is spread with this spreading code.

2.14.3.4.4 Effect of SCCPCH

Like a DPCH, the SCCPCH is spread with the same symbol rate. Therefore, the same conditions that apply to the DPCHs (see section 2.14.3.4.7) apply to the parameters of the SCCPCH.

2.14.3.4.5 Effect of PRACH

The PRACH is not orthogonal to the DPCCH and DPDCHs since the preamble is spread according to a special scheme. This has similar consequences to the use of the perch in the downlink. Mobile stations never use PRACH and DPCCH/DPDCH simultaneously.

2.14.3.4.6 Effect of Long Code Init

The long code init is used to distinguish between the base stations (downlink) and the mobile stations (uplink).
If different initial values are used within a signal, the channels are not orthogonal.
The following example shows the levels measured after despreading:

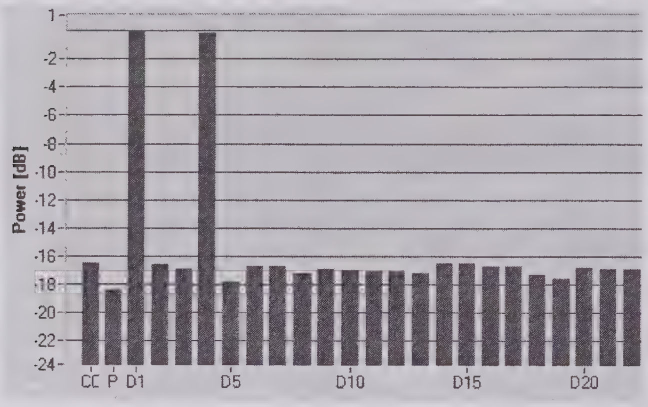


Fig. 2-134 Effect of different long code init values on power distribution

The DPCHs were sent with the spreading code numbers 1 and 4 with the initial value 0, channels 2 and 3 with the initial value 255 (0 dB each). The analysis was carried out at initial value 0.

These level conditions still allow error-free reconstruction of the bit streams of the two DPCHs 1 and 4. A certain guard interval should, however, always be maintained between the transmitted channel power and the measured powers of the other (non-orthogonal) channels.
In this example, a channel power of -10 dB is sufficient for error-free decoding, whereas at a power of -15 dB, the bit error rate is already as high 10%. (The stated values were determined at the physical layer using a CDPA. By using channel coding, error-free reconstruction of the bit stream is possible even under considerably more unfavourable conditions).

2.14.3.4.7 Effect of Symbol Rates and Spreading Code Numbers

A consequence of the law of formation of the spreading code is that with certain symbol rate/spreading code number combinations, identical spreading sequences Si/Sq are generated. This is always the case with spreading code number 0 (all bits 0), but also with the combination 1024 ksps/spreading code 1 (0011) <-> 512 ksps/spreading code 2 (00110011).

As a rule, the spreading sequences are identical if the products of symbol rate and spreading code are equal.

The despreader, therefore, can no longer differentiate between the two channels. Depending on the data contents, the channel powers are either reinforced or cancel out. Recovering all the source data is not possible.

The following signal contains
- a DPCH with 1024 ksps, spreading code number 1, 0 dB, data all 0s
- a DPCH with 512 ksps, spreading code number 2, 0 dB, data all 1s

An analysis at 1024 ksps gives the following result:

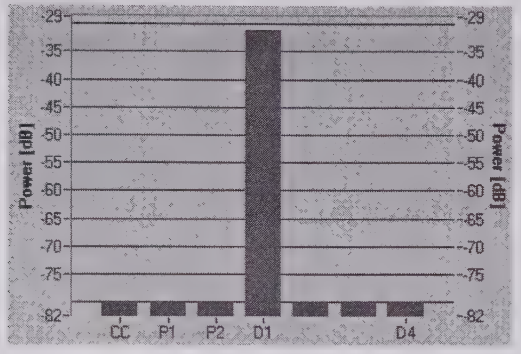


Fig. 2-135 Cancellation possible in case of several channels with identical spreading sequences

Apart from this trivial case, there are other cases where problems may occur. The above example is modified by changing the spreading code number of the second DPCH from 2 to 3:

- a DPCH with 1024 ksps, spreading code number 1, 0 dB, data all 0s,
- a DPCH with 512 ksps, spreading code number 3, 0 dB, data all 1s.

After despreading at a symbol rate of 512 ksps, the following power distribution is obtained:

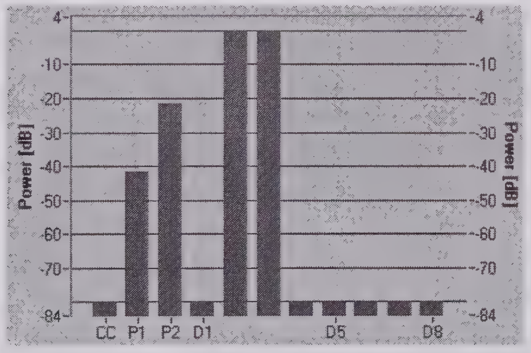


Fig. 2-136 Incorrect detection at various symbol rates

The 1024 ksps channel (spreading code 1) is recognized as channel 2 at 512 ksps. There is, however, no crosstalk on channel 3. Therefore, the 512 ksps channel is detected with the original power and all bits can be restored.

On the other hand, attempting to despread the 1024 ksps channel gives the following power distribution:

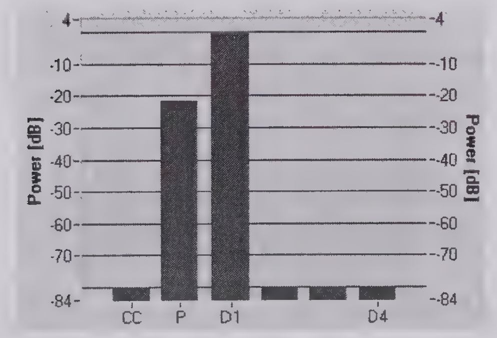


Fig. 2-137 Non-restorable DPCH channel

Both channels coincide with channel 1, despreading is not possible under these level conditions.

If all transmitted DPCHs are to be despread, two channels at half the symbol rate (spreading codes 2n, 2n+1) should be avoided for each used channel with a certain symbol rate (spreading code n). Analogously, this also applies to four channels at a fourth of the symbol rate (spreading codes 4n, 4n+1, 4n+2, 4n+3), etc.
The following table gives an example of a DPCH combination where all channels are to be decoded:

Symbol rate	Spreading code numbers
1024 ksps	0
512 ksps	2
256 ksps	6
128 ksps	14
64 ksps	30
32 ksps	62, 63 – 127

The SMIQ supports the selection of orthogonal spreading code/symbol rate combinations by displaying the code domain power, by means of the code domain conflict warning and by providing a capability for solving these conflicts automatically (see section 2.14.2.9).

2.14.3.5 Simulation of Special Scenarios

It is shown in the following how special scenarios can be simulated by means of SMIQ parameters. The downlink is used as an example, as more scenarios occur. Scenarios of sections 2.14.3.5.1, 2.14.3.5.2 and 2.14.3.5.5 can also be applied to the simulation of mobile station signals.

2.14.3.5.1 Standard Base Station

A standard base station is the simplest base station case.

Activate perch channel (State = ON)

Activate common physical channel CPCH

Activate between 0 and 128 DPCHs.

Select spreading codes and symbol rates so that no code domain conflicts occur.

Set T_{sect} to 0.
(You can also use other values, but this will only have a minor effect on the signal. 0 is assumed in the following.)

Use data offset in channels to model the offsets T_d, and T_o as specified in the 3GPP W-CDMA standard.

2.14.3.5.2 Base Station with more than 128 DPCHs

To prevent the channel table from becoming confusing, a BS in the SMIQ may not have more than 128 DPCHs. If a base station is to have more than 128 DPCHs, these channels must be distributed over several BS.

Use the settings in section 2.14.3.5.1 for the first BS.

Assign the remaining DPCHs to the other BSs.

Select the spreading codes and symbol rates so that no code domain conflicts occur - not even beyond the limits of a BS.

Note: *The SMIQ does not support a code domain power (conflict) display beyond the limits of a MS/BS. With several stations, it is a good idea to divide the available range into subranges (eg BS1: 0 to 256, BS2: 257 to 467, BS3: 468 to 511).*

Set the same values for long code init and T_{Sect} for all BSs.

Note: *The function "Copy BS/MS" (section 2.14.2.1) facilitates the transfer of these values from one BS to another.*

2.14.3.5.3 Base Station with Several Sectors

3GPP W-CDMA envisages a time shift between the individual sectors of a base station. This time shift T_{Sect} can be entered centrally for one BS. If several sectors are to be simulated, a division into several BSs is required as described under section 2.14.3.5.2:

Set several BSs according to section 2.14.3.5.1.

Use the same values for long code init.

Set the required values for T_{Sect} for all BSs.

For the effect of parameter T_{Sect} on the timing of the channels, see section 2.14.2.11.

2.14.3.5.4 Base Station with Spreading Codes Used Several Times

3GPP W-CDMA envisages increasing the number of channels by using primary and secondary scrambling codes.
The PCCPCH and the first part of the DPCHs is then sent with the primary scrambling code, the remaining DPCHs with one of the assigned secondary scrambling codes. The following range of values is given in [2]:
Primary scrambling code: i = 0 to 511
Secondary scrambling code: i + k * 512 with k=1 to 511

Note: *The use of secondary scrambling codes basically gives the same results as the parameter T_{offset} specified in former standards.*

When the secondary scrambling codes are used, orthogonality is impaired and crosstalk is produced (see section 2.14.3.4.6). This scrambling code (long code init) can be entered for a BS. If channels with different scrambling codes are to be simulated, division into several BSs is required as described in section 2.14.3.5.3:

Set several BSs according to section 2.14.3.5.1.

Use the same value of T_{Sect} for all BSs.

Set the required values for long code init.

2.14.3.5.5 Several Base Stations

3GPP W-CDMA base stations can be at different RF frequencies. At present, this case can only be simulated in conjunction with AMIQ/WinIQSIM.
Since there are normally not enough frequencies available, the base stations with the same transmit frequency are distinguished by the primary scrambling code (long code init).

Set the required BS according to section 2.14.3.5.1.

Use any value of T_{Sect} for BS.

Set the required values for long code init for all BSs.

2.14.3.5.6 Overview

Table 2-31 Simulation of various scenarios

Scenario	**BS1 Long Code Init**	**BS1 T_{Sect}**	**BS2-4 long code init**	**BS2-4 T_{Sect}**
Standard (2.14.3.5.1)	0 to 511	0	-	-
>128 DPCHs (2.14.3.5.2)	0 to 511	0	same as BS1	same as BS1
Several sectors (2.14.3.5.3)	0 to 511	0	same as BS1	any
Extended spreading codes (2.14.3.5.4)	i = 0 to 511	0	i + k*512, k = 1 to 511	same as BS1
Several base stations (2.14.3.5.5)	any	0	any	any

2.15 Digital Standard NADC

With the options Modulation Coder (SMIQB20) and Data Generator (SMIQB11) provided, modulation signals according to the American NADC standard (IS-54[1] or IS-136) can be generated. NADC is a TDMA standard for cellular mobile radio networks.

SMIQ can generate both the transmit signal of a base station (BS) and the transmit signal of a mobile station (MS). Transmission from BS to MS is called "downlink", "uplink" being used for transmission in the opposite direction.

Each TDMA frame consists of 6 slots. The 6 slots can be configured for both full rate and half rate mode. For half rate, the data content for each of the 6 slots can be defined separately by means of a slot editor whereas in the full rate mode 2 slots for example slot 1 and 4 are combined in a frame. The settings for the first slot are then automatically used for the assigned second slot. Each slot can be switched on or off. Moreover, a defined intermediate level can be set for uplink slots.

A burst type has to be defined to configure a slot. The following burst types can be selected:

• TCH	a traffic channel burst with a different structure for uplink and downlink,
• SHORT	the so-called "shortened burst" only available during uplink and,
• ALL_DATA	burst type for test purposes with freely programmable data contents in the selected slot.

The following internal modulation sources are available:

- different PRBS generators with a sequence length between 2^9-1 and 2^{23}-1 and
- data lists, ie freely programmable data sequences from the data generator memory.

For generating the NADC signals, SMIQ inserts the modulation data continuously (in real time) into the selected slots. Using a digital signal processor the data generator generates a data sequence with modulation data and control signals for envelope control.

The data generator in SMIQ generates a data stream which is converted into IQ signals in the modulation coder. According to the NADC standard, the modulation type is $\pi/4$ DQPSK at a symbol rate of 24.3 ksymbol/s and √COS filtering. Symbol rate and filtering can be changed in SMIQ.

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[1] Personal Handy Phone System ARIB Standard (RCR STD-28)

2.15.1 Sync and Trigger Signals

The data generator generates a data sequence with modulation data, control signals for envelope control, and synchronization signals.

When TRIGGER MODE AUTO is selected, the NADC signal generation is started automatically.

This start can also be activated by an external trigger signal (TRIGGER MODE ARMED_AUTO) which allows a synchronous sequence for BER measurements to be carried out on receivers.

A trigger signal can be fed via the TRIGIN input at connector PAR DATA. The active slope of a trigger signal applied there executes a trigger event.
NADC signal generation at a frame limit is started after a trigger event. Data from data lists are inserted into the selected slots starting from the first bit. PRBS generators start with the set initialization status.

Signal generation either starts immediately after the active slope of the trigger signal or after a settable number of symbols (EXT TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a settable number of symbols (EXT RETRIGGER INHIBIT).

A trigger event can be executed manually or via the IEC/IEEE bus using EXECUTE TRIGGER.

When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ also generates the following sync signals:

- a frame clock at TRIGOUT 1 output,
- a frame or multiframe clock at TRIGOUT 2 output with settable position in the frame,
- the symbol clock and the bit clock.

A clock synthesizer on the modulation coder generates the symbol clock and the bit clock in SMIQ. All the clock signals are synchronized to the 10-MHz reference of SMIQ. The symbol clock is available at connector SYMBOL CLOCK and the bit clock at connector BIT CLOCK. If required, the clock synthesizer in SMIQ can be synchronized to an external symbol or bit clock.

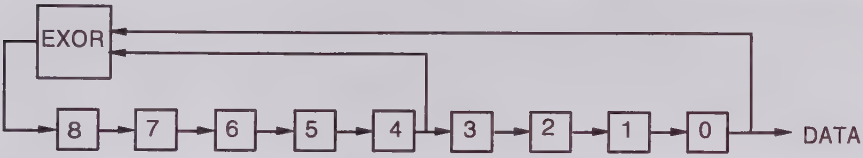
The clock signal is selected in the menu via CLOCK-CLOCK SOURCE EXT.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Note: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.15.2 PN Generators as Internal Data Source

Independent PN generators (Pseudo Noise) can be selected for each slot as data source for data fields DATA and SACCH. These PN generators provide pseudo-random bit sequences of different length or period. That is why they are also called PRBS generators (Pseudo Random Binary Sequence).
Data sequences are sequences of maximum length which are generated by means of feedback shift registers.
The following figure gives an example of a 9 bit generator with feedbacks after register 4 and 0 (output).



The pseudo-random sequence of a PRBS generator is clearly defined by the number of registers and the feedback. The following table describes all PRBS generators available:

Table 2-32 PRBS generators for NADC

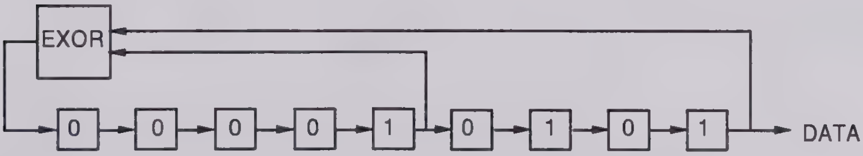
PRBS generator	Length in bits	Feedback after
9 bit	$2^9 -1 = 511$	Register 4, 0
11 bit	$2^{11} -1 =2047$	Register 2, 0
15 bit	$2^{15} -1 = 32767$	Register 1, 0
16 bit	$2^{16} -1 = 65535$	Register 5, 3, 2, 0
20 bit	$2^{20} -1 = 1048575$	Register 3, 0
21 bit	$2^{21} -1 = 2097151$	Register 2, 0
23 bit	$2^{23} -1 = 8388607$	Register 5, 0

PN generators PN9,11,15,20 and PN23 are configured according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generators PN15 and PN23.

The start value of the PN generators is different in the slots and equals

$$\text{start value} = 1 + 14\,\text{hex} \times \text{slot number}$$

Example: PN9 generator in slot 1 with start value 15hex = 10101 binary.



The resulting output sequence is `1010100000010100101011110010` etc.

2.15.3 Lists as Internal Data Source

A freely programmable memory on the data generator serves as internal data source for the data fields of the slots. The data are managed in so-called lists. A list editor allows to select, copy, modify and delete data lists (DATA LIST).
The list editor is available via menu DIGITAL-MOD - SOURCE....

2.15.4 External Modulation Data

External data can (only) be applied via the SERDATA interface. A selection of SERDATA as data source is only possible for a single data field of a slot. For further information on the characteristics of the SERDATA interface see Annex A.

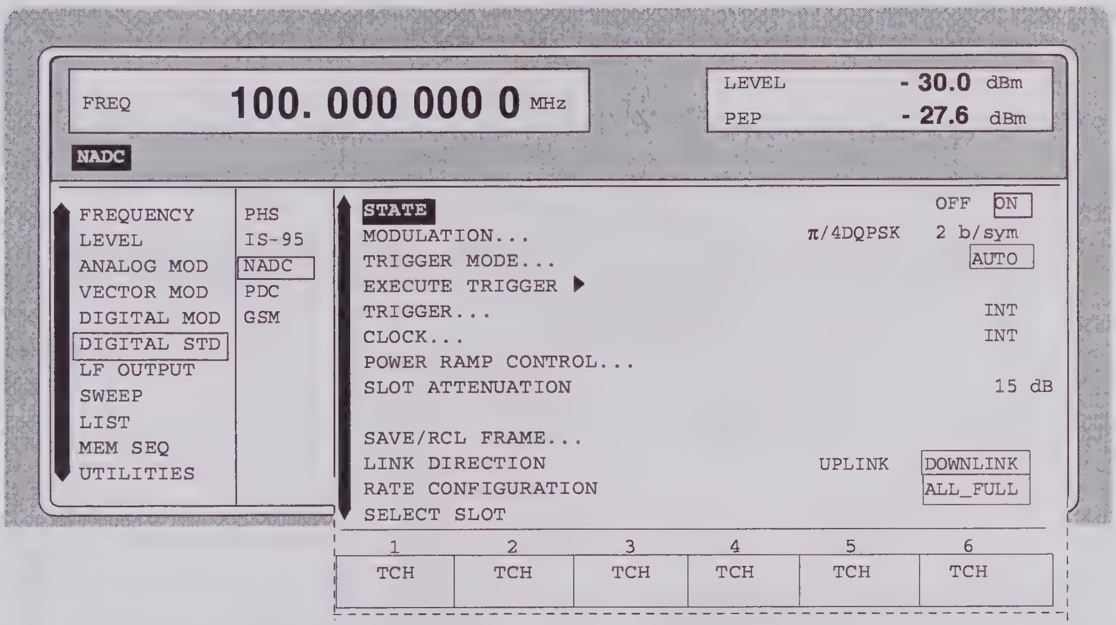
To ensure that the external data bits are assigned to specific positions in the data field of the selected slot and that they are reproducible, the buffer of the RS-232 transmitter and receiver has to be deleted. A triggered start has to follow.
The following setting sequence is required in the DIGITAL STD - NADC menu:

1. Carry out desired settings in menu.
2. Select data source SERDATA for the data field of the slot using SELECT SLOT - ....
3. Make connection to external data source, but do not yet start external data source.
4. Switch off digital standard using STATE - OFF.
5. Set TRIGGER MODE ARMED_AUTO.
   In this state, SMIQ is ready for reception, but discards data that are read in via SERDATA.
6. Switch on digital standard with STATE ON.
7. Start external data source.
   The read-in data are written into the receiving buffer. Only if this buffer is filled can SMIQ react to a trigger event.
8. Activate trigger event. Signal generation is thus started at a frame limit. The first bit received via SERDATA is put to the first bit position in the selected data field.

2.15.5 Menu DIGITAL STANDARD - NADC

Menu DIGITAL STD - NADC provides access to settings for generating NADC signals.

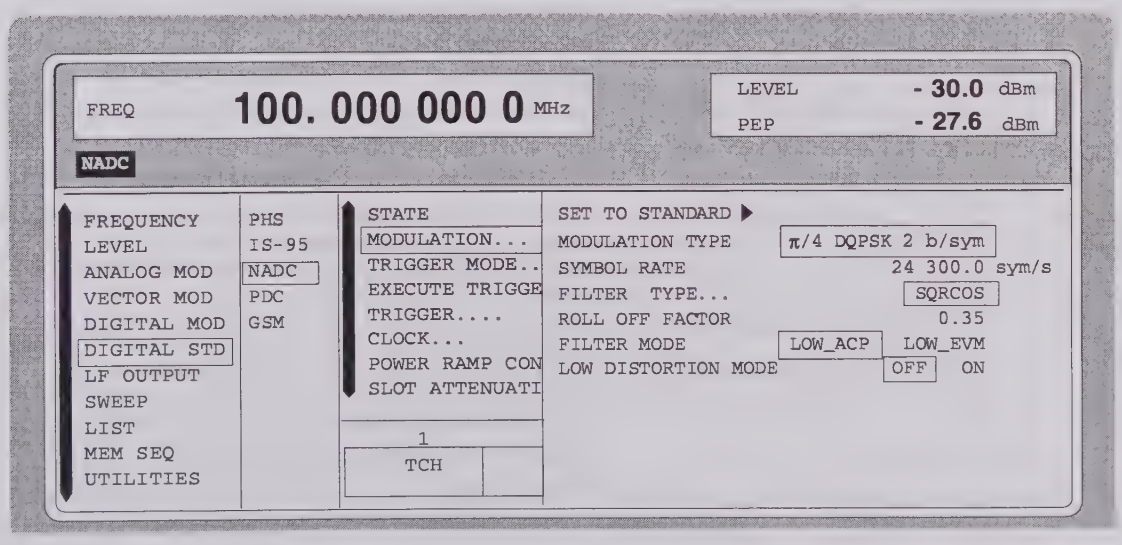
Menu selection: DIGITAL STD - NADC



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 27.6 dBm
STATE OFF ON
MODULATION... π/4DQPSK 2 b/sym
TRIGGER MODE... AUTO
TRIGGER... INT
CLOCK... INT
SLOT ATTENUATION 15 dB
LINK DIRECTION UPLINK DOWNLINK
RATE CONFIGURATION ALL_FULL

Fig. 2-138 Menu DIGITAL STD - NADC, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

STATE	Switch on/off of Digital Standard NADC modulation. Vector Modulation or Digital Modulation will be switched off automatically. IEC/IEEE-bus command `:SOUR:NADC:STAT ON`
MODULATION...	Opens a window for setting the modulation parameters.



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 27.6 dBm
MODULATION TYPE π/4 DQPSK 2 b/sym
SYMBOL RATE 24 300.0 sym/s
FILTER TYPE... SQRCOS
ROLL OFF FACTOR 0.35
FILTER MODE LOW_ACP LOW_EVM
LOW DISTORTION MODE OFF ON

Fig. 2-139 Menu DIGITAL STD - NADC - MODULATION..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

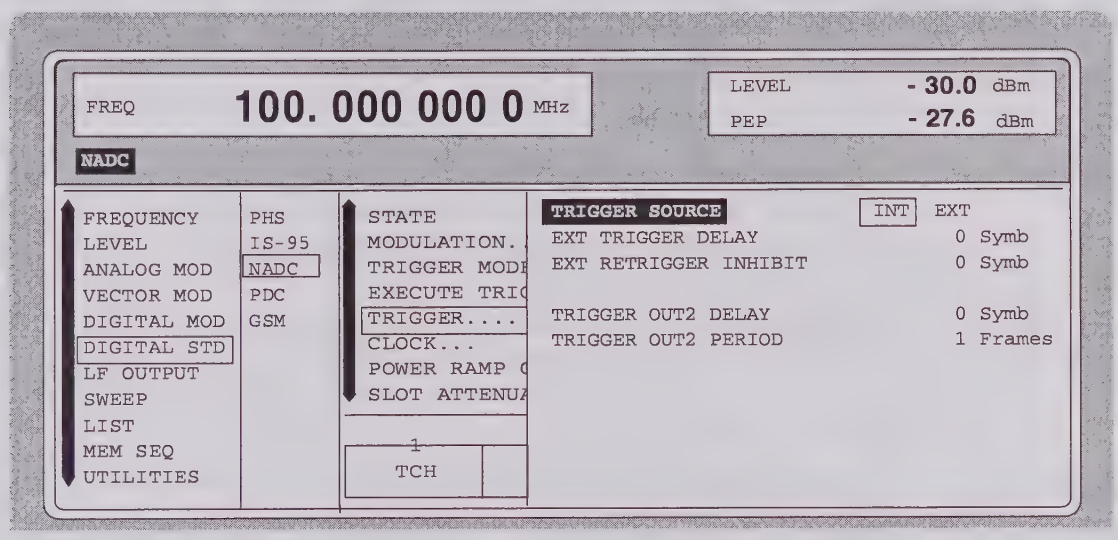
(MODULATION...)	**SET TO STANDARD ▶**	Sets the subsequent modulation parameters to the values predefined by the standard.
	MODULATION TYPE	Displays the modulation type.
	SYMBOL RATE	Input value for the symbol clock. 24.3 ksymbol/s are preset. IEC/IEEE-bus `:SOUR:NADC:SRAT 24.31KHZ`
	FILTER	Selection of baseband filter. A selection between Nyquist filters COS and SQRCOS is possible. IEC/IEEE-bus `:SOUR:NADC:FILT:TYPE COS`
	ROLL OFF FACTOR	Input value for the roll-off factor. IEC/IEEE-bus `:SOUR:NADC:FILT:PAR 0.35`
	FILTER MODE	Selection of filter mode. LOW_ACP Filter for minimum Adjacent Channel Power. IEEE `:SOUR:NADC:FILT:MODE LACP` LOW_EVM Filter for minimum vector error. IEEE `:SOUR:NADC:FILT:MODE LEVM`
	LOW DISTORTION	Switch on/off of low-distortion mode.. After switch-on, the level of the IQ baseband signals is reduced by 3 dB. In some cases, this might reduce undesired intermodulation products. OFF is normally the more favourable setting. IEC/IEEE-bus command `:SOUR:NADC:LDIS OFF`

TRIGGER MODE... Opens a window for selecting the trigger mode.

AUTO	The NADC signals are continuously transmitted in the activated slots. IEC/IEEE-bus `:SOUR:NADC:SEQ AUTO`
RETRIG	The NADC signals are continuously transmitted in the activated slots. A trigger event causes a restart. IEC/IEEE-bus `:SOUR:NADC:SEQ RETR`
ARMED_AUTO	The NADC signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus `:SOUR:NADC:SEQ AAUT`
ARMED_RETRIG	The NADC signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the RETRIG mode. Each new trigger event causes a restart. IEC/IEEE-bus `:SOUR:NADC:SEQ ARET`

EXECUTE TRIGGER ▶ Executes a trigger even to start the NADC signal generation.
IEC/IEEE-bus command `:TRIG:DM:IMM`

TRIGGER... Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.


FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 27.6 dBm

TRIGGER SOURCE INT EXT
EXT TRIGGER DELAY 0 Symb
EXT RETRIGGER INHIBIT 0 Symb
TRIGGER OUT2 DELAY 0 Symb
TRIGGER OUT2 PERIOD 1 Frames

Fig. 2-140 Menu DIGITAL STD - NADC_TRIGGER..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(TRIGGER...) **TRIGGER SOURCE** Selection of trigger source.

EXT The NADC signal generation is started by the active slope of an external trigger signal.
The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.

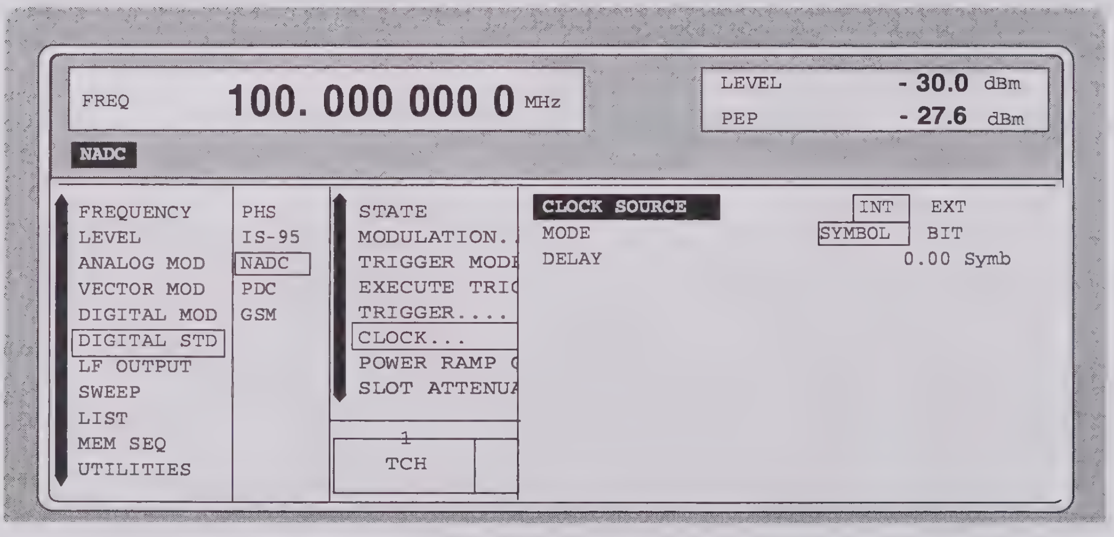
INT A trigger event can be executed by EXECUTE TRIGGER ▶.

IEC/IEEE-bus `:SOUR:NADC:TRIG:SOUR EXT`

EXT TRIGGER DELAY Setting the number of symbols by which an external trigger signal is delayed before it starts the NADC signal generation.
This is used for setting the time synchronization between the the SMIQ and the DUT.

IEC/IEEE-bus `:SOUR:NADC:TRIG:DEL 3`

(TRIGGER...)	**EXT RETRIGGER INHIBIT**	Setting the number of symbols for which a restart is inhibited after a trigger event. With TRIGGER MODE RETRIG selected, each new trigger signal restarts the NADC signal generation. This restart can be inhibited for the entered number of symbols. Example: The entry of 1000 symbols causes new trigger signals to be ignored for the duration of 1000 symbols after a trigger event IEC/IEEE-bus `:SOUR:NADC:TRIG:INH 1000`
	TRIGGER OUT 2 DELAY	Input value of delay of trigger signal at TRIGOUT 2 output compared with beginning of frame. IEC/IEEE-bus `:SOUR:NADC:TRIG:OUTP:DEL 2`
	TRIGGER OUT2 PERIOD	Input value of output signal period at TRIGOUT 2 output given in frames. IEC/IEEE-bus `:SOUR:NADC:TRIG:OUTP:PER 1`
CLOCK...	Opens a window for selecting the clock source and for setting a delay.	


FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

CLOCK SOURCE INT EXT

MODE SYMBOL BIT

DELAY 0.00 Symb

Fig. 2-141 Menu DIGITAL STD - NADC - CLOCK..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(CLOCK...)

CLOCK SOURCE

Selection of clock source.

INT	SMIQ uses internally generated clock signals.
EXT	An external symbol clock or bit clock is fed in at connectors SYMBOL CLOCK or BIT CLOCK. The clock synthesizer on the modulation coder is synchronized to this clock. The symbol rate has to be set with an accuracy of ± 1 %. The polarity, the trigger threshold and the input resistance of the clock inputs can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus command `:SOUR:NADC:CLOC:SOUR INT`

MODE

Selection of clock for external clock signal.

SYMBOL	The external clock has to be a symbol clock.
BIT	The external clock has to be a bit clock.

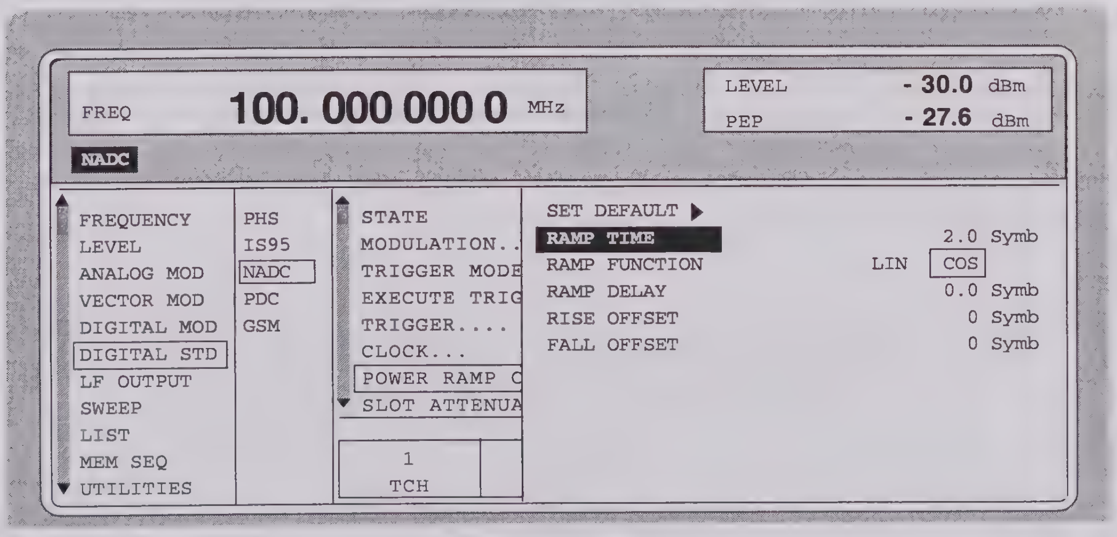
IEC/IEEE-bus command `:SOUR:NADC:CLOC:MODE SYMB`

DELAY

Setting the delay of generated modulation signal to an external clock.
This can be used, for example, for synchronization with a second unit to achieve time synchronization between the modulation signals of the two units.

IEC/IEEE-bus command `:SOUR:NADC:CLOC:DEL 0.5`

POWER RAMP CONTROL... Opens a window for setting the envelope control, especially for the rising and falling ramp at the beginning and end of a slot.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

RAMP TIME 2.0 Symb

RAMP FUNCTION LIN COS

RAMP DELAY 0.0 Symb

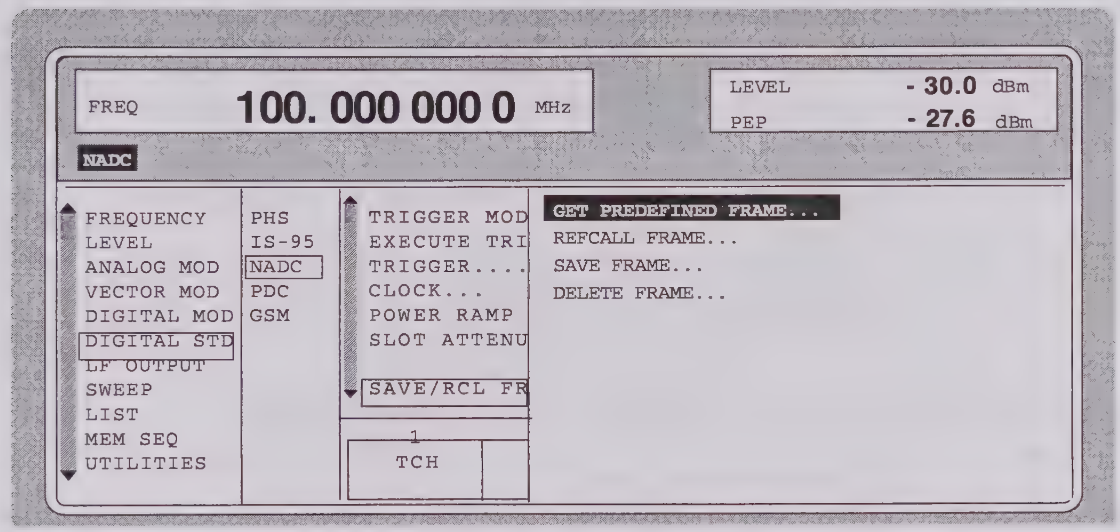
RISE OFFSET 0 Symb

FALL OFFSET 0 Symb

Fig. 2-142 Menu DIGITAL STD - NADC - POWER RAMP CONTROL... , SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(POWER RAMP CONTROL...)	**SET DEFAULT ▶**	Resets the subsequent parameters to the factory-set values. IEC/IEEE-bus `:SOUR:NADC:PRAM:PRES`
	RAMP TIME	Input value for the rise and fall time of the envelope at the beginning or end of a slot. The time is set in units of symbol period. IEC/IEEE-bus `:SOUR:NADC:PRAM:TIME 0.25`
	RAMP FUNCTION	Selection of shape of rising and falling ramp for envelope control. LIN Linear ramp function. COS Cosine function. A more favourable spectrum than that of the LIN function is obtained. IEC/IEEE-bus `:SOUR:NADC:PRAM:SHAP LIN`
	RAMP DELAY	Input value for a shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope. The values are set in the units of the symbol length. IEC/IEEE-bus `SOUR:NADC:PRAM:DEL 0.1`
	RISE OFFSET	Input value for a positive or negative offset of the rising ramp of the envelope at the beginning of a slot. IEC/IEEE-bus `:SOUR:NADC:PRAM:ROFF -1`
	FALL OFFSET	Input value for a positive or negative offset of the falling ramp of the envelope at the end of a slot. IEC/IEEE-bus `:SOUR:NADC:PRAM:LOFF 1`
SLOT ATTENUATION	Input value for the level reduction in dB of all active slots whose SLOT LEVEL was set to ATTEN. Menu SELECT SLOT allows the slots to be determined whose level is to be reduced. IEC/IEEE-bus command `:SOUR:NADC:SLOT:ATT 40 DB`	

SAVE/RCL FRAME... Opens a window for saving and loading a frame configuration. Loading a frame affects all parameters that can be set under SELECT SLOT.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

Fig. 2-143 Menu DIGITAL STD - NADC - SAVE/RCL FRAME, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SAVE/RCL FRAME...) GET PREDEFINED FRAME... Loads a factory-set frame configuration.

DN_TCH	Downlink traffic channels in all slots.
UP1TCH	Uplink traffic channels in slot 1

IEEE `:SOUR:NADC:FLIS:PRED:LOAD "dn_tch"`

RECALL FRAME Loads a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:NADC:FLIS:LOAD "name"`

SAVE FRAME Saves a user-defined frame configuration.

IEC/IEEE-bus `:SOUR:NADC:FLIS:STOR "name"`

DELETE FRAME Deletes a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:NADC:FLIS:DEL "name"`

LINK DIRECTION Selection between UPLINK and DOWNLINK. Depending on this selection, various burst types are offered under SELECT SLOT.

IEC/IEEE-bus command `:SOUR:NADC:LINK UP`

RATE CONFIGURATION... Opens a window for determining which slots in the frame are to be configured as half-rate and full-rate channels. Full-rate channels occupy two slots in a frame, the second slot is fully determined by the configuration of the first slot. The following eight combinations can be selected:

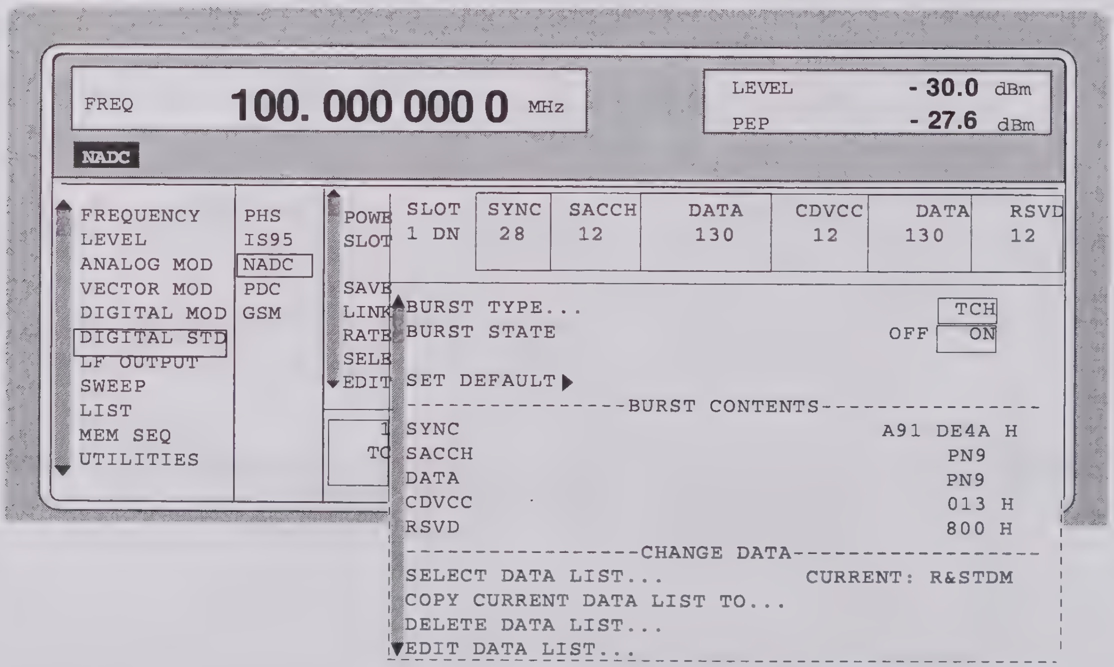
Selection	Full-rate slots	Half-rate slots
ALL HALF	-	1, 2, 3, 4, 5, 6
FULL 1	1 + 4	2, 3, 5, 6
FULL 2	2 + 5	1, 3, 4, 6
FULL 3	3 + 6	1, 2, 4, 5
FULL 1+2	1 + 4 and 2 + 5	3, 6
FULL 1+3	1 + 4 and 3 + 6	2, 5
FULL 2+3	2 + 5 and 3 + 6	1, 4
ALL FULL	1 + 4 and 2 + 5 and 3 + 6	-

IEC/IEEE-bus command `:SOUR:NADC:RCON AHAL`

SELECT SLOT... Selection of one of 6 possible slots. The number depends on the setting under RATE CONFIGURATION. When selecting the slot, a window is opened in which the data contents belonging to this slot can be defined. The content of the window depends on whether an UPLINK or DOWNLINK was selected under LINK DIRECTION.

If the cursor is placed onto a slot in the diagram, it may be switched on and off by pressing one of the unit keys (toggle function).

Menu selection: BURST TYPE = TCH



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.6 dBm

NADC

SLOT 1 DN	SYNC	SACCH	DATA	CDVCC	DATA	RSVD
	28	12	130	12	130	12

```
BURST TYPE...                                   TCH
BURST STATE                               OFF   ON

SET DEFAULT ▶
----------------BURST CONTENTS----------------
SYNC                                 A91 DE4A H
SACCH                                       PN9
DATA                                        PN9
CDVCC                                     013 H
RSVD                                      800 H
-----------------CHANGE DATA-----------------
SELECT DATA LIST...           CURRENT: R&STDM
COPY CURRENT DATA LIST TO...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-144 Menu DIGITAL STD - NADC - SELECT SLOT, LINK DIRECTION = DOWNLINK, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) TCH

BURST TYPE

Selection of burst type used to configure the selected slot.

TCH Traffic channel burst

IEC/IEEE-bus `:SOUR:NADC:SLOT2:TYPE TCH`

SLOT LEVEL
(UPLINK only)

Selection of level for selected slot.

OFF Maximum attenuation
IEC/IEEE `:SOUR:NADC:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.
IEC/IEEE `:SOUR:NADC:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.
IEC/IEEE `:SOUR:NADC:SLOT2:LEV ATT`

BURST STATE
(DOWNLINK only)

Substitute for parameter SLOT LEVEL for DOWNLINK.

ON The burst contents defined in the data fields are sent in the selected slot.
IEC/IEEE-bus `:SOUR:NADC:SLOT2:LEV FULL`

OFF Only 1s will be sent.
IEC/IEEE-bus `:SOUR:NADC:SLOT2:LEV OFF`

Parameter SLOT LEVEL is omitted since the NADC base station in downlink always sends with the same power in each slot.

SET DEFAULT ▶

Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus command `:SOUR:NADC:SLOT8:PRES`

G
(UPLINK only)

Display of data contents in the 6 bit data field "Guard" in hexadecimal form.

R
(UPLINK only)

Display of data contents in the 6 bit data field "Ramp".

DATA

Selection of data source for DATA fields. These fields are regarded as a continuous field, ie a pseudo-random sequence is fully continued from one DATA field to the next. The following data sources are available:

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEEE `:SOUR:NADC:SLOT3:DATA PN15`

DLIST Data from a programmable data list.
IEEE `:SOUR:NADC:SLOT3:DATA DLIS`

SERDATA Data from data input SER DATA.
IEEE `:SOUR:NADC:SLOT3:DATA SDAT`

(SELECT SLOT...) TCH

SYNC

Input value for the 28 bit sync word in hexadecimal form. Depending on the selected slot, the following sync words are predefined according to the NADC standard:

SLOT 1	`A91DE4A`
SLOT 2	`A9D127A`
SLOT 3	`C7E3C0C`
SLOT 4	`342C3F3`
SLOT 5	`13E23D1`
SLOT 6	`DC2EC1D`

IEC/IEEE-bus `:SOUR:NADC:SLOT2:SYNC A91EE4A`

SACCH

Selection of data source for SACCH field (Slow Associated Control Channel).

PN..	PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1. IEEE `:SOUR:NADC:SLOT3:SACC PN15`
DLIST	Data from a programmable data list. IEEE `:SOUR:NADC:SLOT3:SACC DLIS`
SERDATA	Data from data input SER DATA. IEEE `:SOUR:NADC:SLOT3:SACC SDAT`

CDVCC

Input value for the 12 bit "Coded digital verification color code" field in hexadecimal form. SMIQ does not perform any coding but directly accepts the input data. 013 hex. is preset. This corresponds to a value of 1 for the uncoded colour code DVCC.

IEC/IEEE-bus `:SOUR:NADC:SLOT2:CDVC #HFFF`

RSVD (DOWNLINK only)

Input value for the 12 bit "Reserved" field in hexadecimal form.

IEC/IEEE-bus `:SOUR:NADC:SLOT2:CDVC #HFFF`

SELECT DATA LIST...

Opens a window for selecting a stored data list or for generating a new list.

COPY CURRENT DATA LIST TO...

Stores the current data list under a different name.

DELETE DATA LIST...

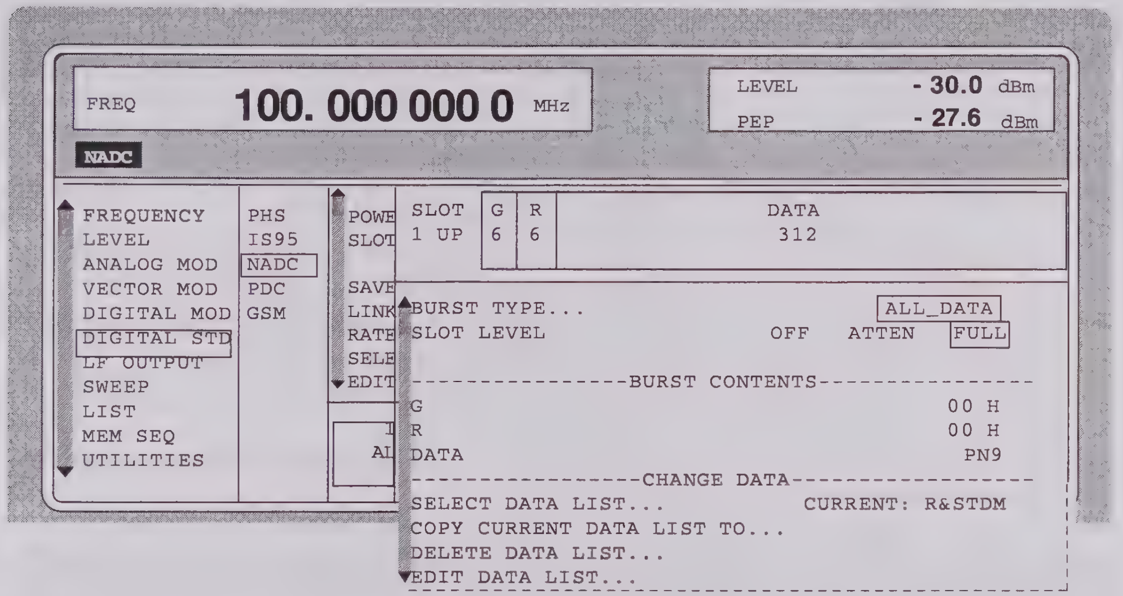
Deletes a data list.

EDIT DATA LIST...

Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

Menu selection: BURST TYPE = ALL_DATA



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm
PEP - 27.6 dBm

SLOT	G	R	DATA
1 UP	6	6	312

BURST TYPE... ALL_DATA
SLOT LEVEL OFF ATTEN FULL

----------------BURST CONTENTS----------------
G 00 H
R 00 H
DATA PN9

----------------CHANGE DATA----------------
SELECT DATA LIST... CURRENT: R&STDM
COPY CURRENT DATA LIST TO...
DELETE DATA LIST...
EDIT DATA LIST...

Fig. 2-145 Menu DIGITAL STD - NADC - SELECT SLOT, LINK DIRECTION = UPLINK,SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) ALL_DATA

BURST TYPE

Selection of burst type used to configure the selected slot.

ALL DATA Burst type for testing with freely programmable data contents

IEC/IEEE-bus `:SOUR:NADC:SLOT2:TYPE ADAT`

SLOT LEVEL (UPLINK only)

Selection of level for selected slot.

OFF Maximum attenuation
IEC/IEEE `:SOUR:NADC:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.
IEC/IEEE `:SOUR:NADC:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.
IEC/IEEE `:SOUR:NADC:SLOT2:LEV ATT`

BURST STATE (DOWNLINK only)

Substitute for parameter SLOT LEVEL for LINK DIRECTION = DOWNLINK.

ON The burst contents defined in the data fields are sent in the selected slot.

OFF Only 1s will be sent.

Parameter SLOT LEVEL is omitted since the NADC base station in downlink always sends with the same power in each slot.

IEC/IEEE-bus command `:SOUR:NADC:SLOT2:LEV FULL`

G (UPLINK only)

Display of data contents in the 6 bit data field "Guard" in hexadecimal form.

(SELECT SLOT...) ALL_DATA **R** (UPLINK only)

Display of data contents in the 6 bit data field "Ramp".

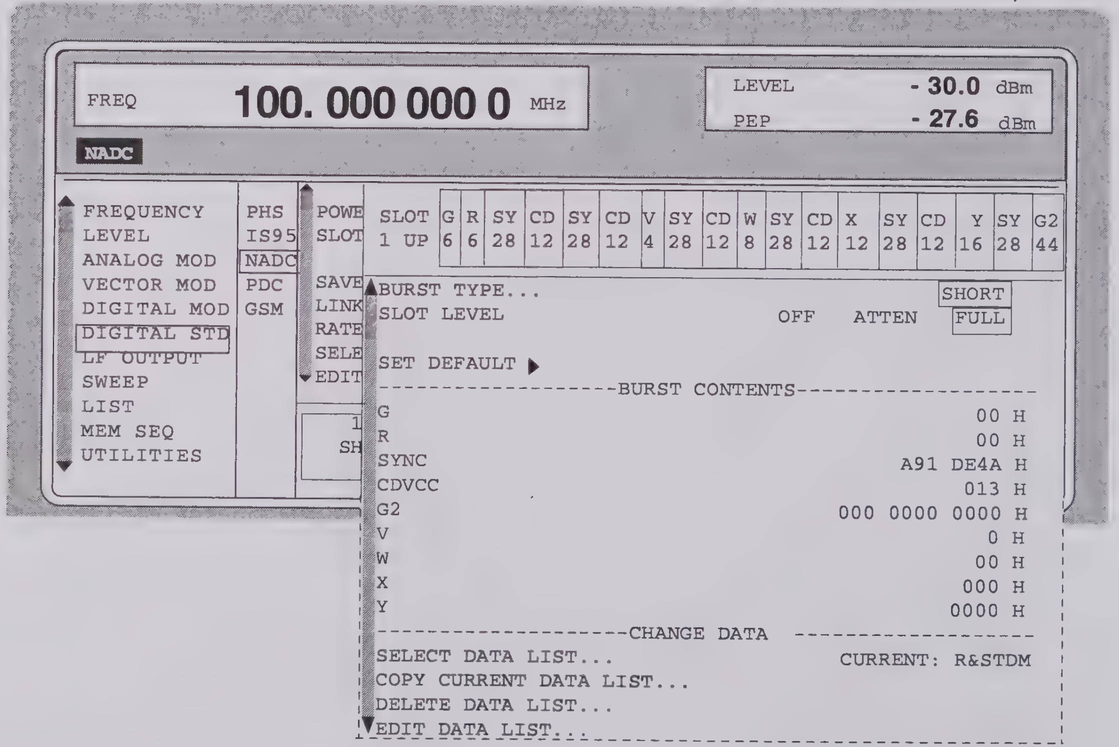
DATA

Selection of data source for DATA fields. These fields are regarded as a continuous field, ie a pseudo-random sequence is fully continued from one DATA field to the next. The following data sources are available:

PN..	PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
	IEEE `:SOUR:NADC:SLOT3:DATA PN15`
DLIST	Data from a programmable data list.
	IEEE `:SOUR:NADC:SLOT3:DATA DLIS`
SERDATA	Data from data input SER DATA.
	IEEE `:SOUR:NADC:SLOT3:DATA SDAT`

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see menu selection BURST TYPE = TCH

Menu selection: BURST TYPE = SHORT (only available with LINK DIRECTION = UPLINK)



SLOT 1 UP	G 6	R 6	SY 28	CD 12	SY 28	CD 12	V 4	SY 28	CD 12	W 8	SY 28	CD 12	X 12	SY 28	CD 12	Y 16	SY 28	G2 44

```
BURST TYPE...                                    SHORT
SLOT LEVEL                      OFF    ATTEN     FULL

SET DEFAULT ▶
------------------BURST CONTENTS------------------
G                                               00 H
R                                               00 H
SYNC                                      A91 DE4A H
CDVCC                                          013 H
G2                                   000 0000 0000 H
V                                                0 H
W                                               00 H
X                                              000 H
Y                                             0000 H
--------------------CHANGE DATA ------------------
SELECT DATA LIST...                  CURRENT: R&STDM
COPY CURRENT DATA LIST...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-146 Menu DIGITAL STD - NADC - SELECT SLOT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) SHORT (UPLINK ONLY) **BURST TYPE**

Selection of burst type used to configure the selected slot.

SHORT	Shortened Burst

IEC/IEEE-bus `:SOUR:NADC:SLOT2:TYPE SHOR`

(SELECT SLOT...) SHORT (UPLINK ONLY)

SLOT LEVEL

Selection of level for selected slot.

OFF — Maximum attenuation

IEC/IEEE `:SOUR:NADC:SLOT2:LEV OFF`

FULL — The level corresponds to the value indicated on the SMIQ LEVEL display.

IEC/IEEE `:SOUR:NADC:SLOT2:LEV FULL`

ATTEN — The level is reduced by the value set under SLOT ATTENUATION.

IEC/IEEE `:SOUR:NADC:SLOT2:LEV ATT`

SET DEFAULT ▶

Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus command `:SOUR:NADC:SLOT8 PRES`

G

Display of data contents in the 6 bit data field "Guard" in hexadecimal form.

R

Display of data contents in the 6 bit data field "Ramp" in hexadecimal form..

SYNC

Input value for the sync word in hexadecimal form. Depending on the selected slot, the following sync words are predefined according to the NADC standard:

SLOT 1	`A91DE4A`
SLOT 2	`A9D127A`
SLOT 3	`C7E3C0C`
SLOT 4	`342C3F3`
SLOT 5	`13E23D1`
SLOT 6	`DC2EC1D`

IEC/IEEE-bus `:SOUR:NADC:SLOT2:SYNC A91EE4A`

CDVCC

Input value for the 12 bit "Coded digital verification color code" field in hexadecimal form. SMIQ does not perform any coding but directly accepts the input data. 013 hex. is preset. This corresponds to a value of 1 for the uncoded colour code DVCC.

IEC/IEEE-bus `:SOUR:NADC:SLOT2:CDVC #HFFF`

V, W, X, Y

Display of data contens of other data fields that are predefined by the NADC standard.

G2

Display of data contents in the second "Guard" in hexadecimal form.

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see menu selection BURST TYPE = TCH

2.16 Digital Standard PDC

With the options Modulation Coder (SMIQB20) and Data Generator (SMIQB11) provided, modulation signals according to the Japanese PDC standard[1] can be generated. PDC is a TDMA standard for cellular mobile radio networks.

SMIQ can generate both the transmit signal of a base station (BS) and the transmit signal of a mobile station (MS). Transmission from BS to MS is called "downlink", "uplink" being used for transmission in the opposite direction.

Each TDMA frame consists of 6 slots. The 6 slots can be configured for both full rate and half rate mode. For half rate, the data content for each of the 6 slots can be defined separately by means of a slot editor whereas in the full rate mode 2 slots for example slot 1 and 4 are combined in a frame. The settings for the first slot are then automatically used for the assigned second slot. Each slot can be switched on or off. Moreover, a defined intermediate level can be set for uplink slots.

A burst type has to be defined to configure a slot. The following burst types can be selected:

- TCH a traffic channel burst with a different structure for uplink and downlink,
- SYNC a burst type for simulation of a sync channel,
- VOX a burst type which is only available in uplink for simulating a communication channel in speech intervals,
- ALL_DATA burst type for test purposes with freely programmable data contents in the selected slot.

For TCH and VOX bursts, SMIQ supports the generation of superframes with a length of 18 frames. The frame position of the so-called "housekeeping channel" RCH can be set in the superframe. According to the standard, the beginning of the superframe is marked by a special sync word in the SYNC data field of the first slot.

The following internal modulation sources are available:

- different PRBS generators with a sequence length between 2^9-1 and 2^{23}-1 and
- data lists, ie freely programmable data sequences from the data generator memory.

For generating the PDC signals, SMIQ inserts the modulation data continuously (in real time) into the selected slots. Using a digital signal processor the data generator generates a data sequence with modulation data and control signals for envelope control.

The data generator in SMIQ generates a data stream which is converted into IQ signals in the modulation coder. According to the PDC standard, the modulation type is $\pi/4$ DQPSK at a symbol rate of 21 ksymbol/s and $\sqrt{}$COS filtering. Symbol rate and filtering can be changed in SMIQ.

---

[1] Personal Digital Cellular Telecommunication System, RCR STD-27 D

2.16.1 Sync and Trigger Signals

The data generator generates a data sequence with modulation data, control signals for envelope control, and synchronization signals.

When TRIGGER MODE AUTO is selected, the PDC signal generation is started automatically.

This start can also be activated by an external trigger signal (TRIGGER MODE ARMED_AUTO) which allows a synchronous sequence for BER measurements to be carried out on receivers.

A trigger signal can be fed via the TRIGIN input at connector PAR DATA. The active slope of a trigger signal applied there executes a trigger event.
PDC signal generation at a frame or a super frame limit is started after a trigger event. Data from data lists are inserted into the selected slots starting from the first bit. PRBS generators start with the set initialization status.

Signal generation either starts immediately after the active slope of the trigger signal or after a settable number of symbols (EXT TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a settable number of symbols (EXT RETRIGGER INHIBIT).

A trigger event can be executed manually or via the IEC/IEEE bus using EXECUTE TRIGGER.

When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ also generates the following sync signals:

- a frame clock at TRIGOUT 1 output,
- a frame or multiframe clock at TRIGOUT 2 output with settable position in the frame,
- the symbol clock and the bit clock.

A clock synthesizer on the modulation coder generates the symbol clock and the bit clock in SMIQ. All the clock signals are synchronized to the 10-MHz reference of SMIQ. The symbol clock is available at connector SYMBOL CLOCK and the bit clock at connector BIT CLOCK. If required, the clock synthesizer in SMIQ can be synchronized to an external symbol or bit clock.

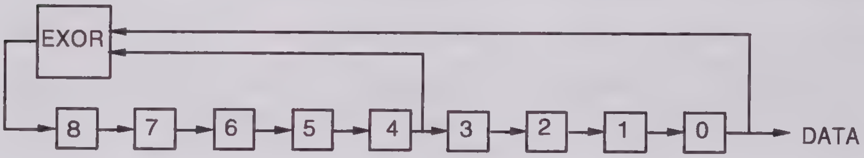
The clock signal is selected in the menu via CLOCK-CLOCK SOURCE EXT.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Note: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.16.2 PN Generators as Internal Data Source

Independent PN generators (Pseudo Noise) can be selected for each slot as data source for data fields DATA, SACCH, RCH and SI. These PN generators provide pseudo-random bit sequences of different length or period. That is why they are also called PRBS generators (Pseudo Random Binary Sequence). Data sequences are sequences of maximum length which are generated by means of feedback shift registers.
The following figure gives an example of a 9 bit generator with feedbacks after register 4 and 0 (output).



The pseudo-random sequence of a PRBS generator is clearly defined by the number of registers and the feedback. The following table describes all PRBS generators available:

Table 2-33 PRBS generators for PDC

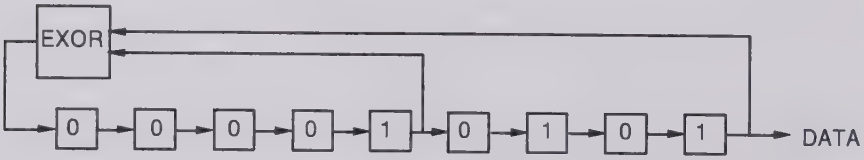
PRBS generator	Length in bits	Feedback after
9 bit	$2^9 -1 = 511$	Register 4, 0
11 bit	$2^{11} -1 =2047$	Register 2, 0
15 bit	$2^{15} -1 = 32767$	Register 1, 0
16 bit	$2^{16} -1 = 65535$	Register 5, 3, 2, 0
20 bit	$2^{20} -1 = 1048575$	Register 3, 0
21 bit	$2^{21} -1 = 2097151$	Register 2, 0
23 bit	$2^{23} -1 = 8388607$	Register 5, 0

PN generators PN9,11,15,20 and PN23 are configured according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generators PN15 and PN23.

The start value of the PN generators is different in the slots and equals

$$\text{start value} = 1 + 14\,\text{hex} \times \text{slot number}$$

Example: PN9 generator in slot 1 with start value 15hex = 10101 binary.



The resulting output sequence is `10101000000101001010111110010` etc.

2.16.3 Lists as Internal Data Source

A freely programmable memory on the data generator serves as internal data source for the data fields of the slots. The data are managed in so-called lists. A list editor allows to select, copy, modify and delete data lists (DATA LIST).
The list editor is available via menu DIGITAL-MOD - SOURCE....

2.16.4 External Modulation Data

External data can (only) be applied via the SERDATA interface. A selection of SERDATA as data source is only possible for a single data field of a slot. For further information on the characteristics of the SERDATA interface see Annex A.

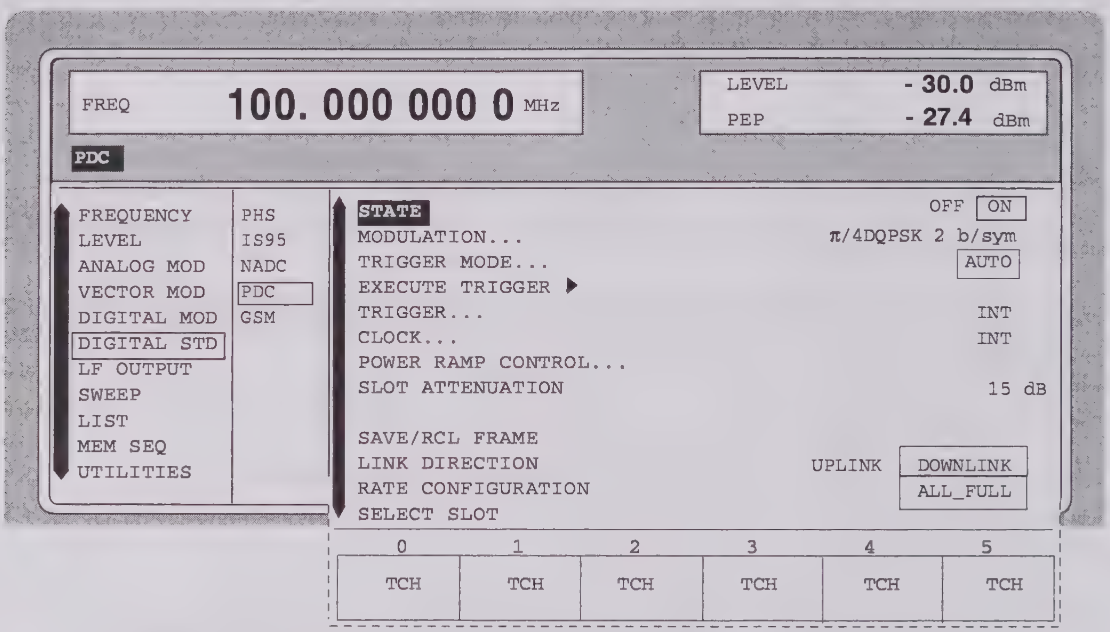
To ensure that the external data bits are assigned to specific positions in the data field of the selected slot and that they are reproducible, the buffer of the RS-232 transmitter and receiver has to be deleted. A triggered start has to follow.
The following setting sequence is required in the DIGITAL STD - PDC menu:

1. Carry out desired settings in menu.
2. Select data source SERDATA for the data field of the slot using SELECT SLOT - ....
3. Make connection to external data source, but do not yet start external data source.
4. Switch off digital standard using STATE - OFF.
5. Set TRIGGER MODE ARMED_AUTO.
   In this state, SMIQ is ready for reception, but discards data that are read in via SERDATA.
6. Switch on digital standard with STATE ON.
7. Start external data source.
   The read-in data are written into the receiving buffer. Only if this buffer is filled can SMIQ react to a trigger event.
8. Activate trigger event. Signal generation is thus started at a frame limit. The first bit received via SERDATA is put to the first bit position in the selected data field.

2.16.5 Menu DIGITAL STANDARD - PDC

Menu DIGITAL STD - PDC provides access to settings for generating PDC signals.

Menu selection: DIGITAL STD - PDC



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.4 dBm

STATE OFF ON

MODULATION... π/4DQPSK 2 b/sym

TRIGGER MODE... AUTO

TRIGGER... INT

CLOCK... INT

SLOT ATTENUATION 15 dB

LINK DIRECTION UPLINK DOWNLINK

RATE CONFIGURATION ALL_FULL

SELECT SLOT

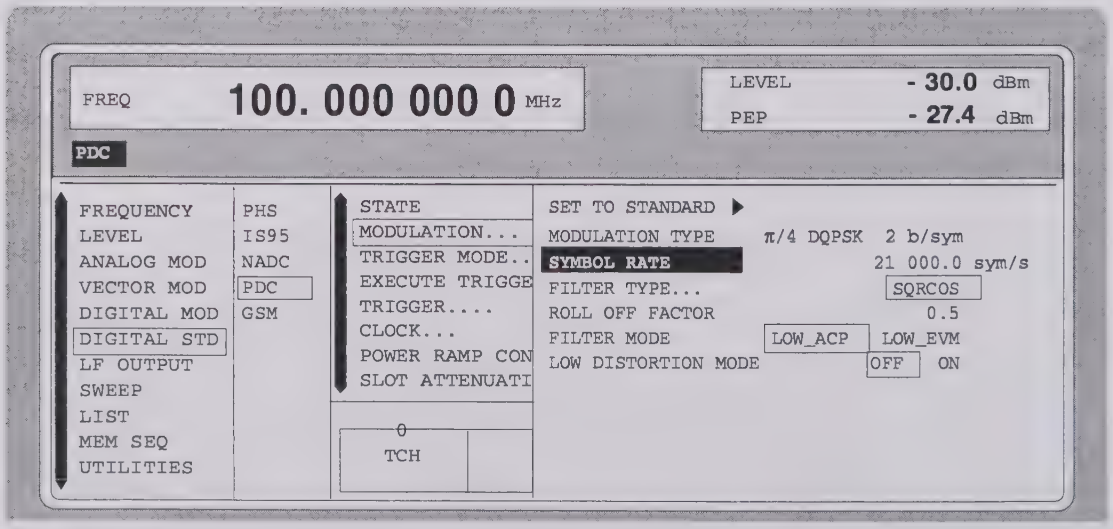
0	1	2	3	4	5
TCH	TCH	TCH	TCH	TCH	TCH

Fig. 2-147 Menu DIGITAL STD - PDC, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

STATE Switch on/off of Digital Standard PDC modulation. Vector Modulation or Digital Modulation will be switched off automatically.

IEC/IEEE-bus command `:SOUR:PDC:STAT ON`

MODULATION... Opens a window for setting the modulation parameters.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.4 dBm

MODULATION TYPE π/4 DQPSK 2 b/sym

SYMBOL RATE 21 000.0 sym/s

FILTER TYPE... SQRCOS

ROLL OFF FACTOR 0.5

FILTER MODE LOW_ACP LOW_EVM

LOW DISTORTION MODE OFF ON

Fig. 2-148 Menu DIGITAL STD - PDC - MODULATION..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(MODULATION...)	**SET TO STANDARD ▶**	Sets the subsequent modulation parameters to the values predefined by the standard.
	MODULATION TYPE	Displays the modulation type.
	SYMBOL RATE	Input value for the symbol clock. 21 ksymbol/s are preset. IEC/IEEE-bus `:SOUR:PDC:SRAT 21.1KHZ`
	FILTER	Selection of baseband filter. A selection between Nyquist filters COS and SQRCOS is possible. IEC/IEEE-bus `:SOUR:PDC:FILT:TYPE COS`
	ROLL OFF FACTOR	Input value for the roll-off factor. IEC/IEEE-bus `:SOUR:PDC:FILT:PAR 0.51`
	FILTER MODE	Selection of filter mode. LOW_ACP Filter for minimum Adjacent Channel Power. IEC `:SOUR:PDC:FILT:MODE LACP` LOW_EVM Filter for minimum vector error. IEC `:SOUR:PDC:FILT:MODE LEVM`
	LOW DISTORTION	Switch on/off of low-distortion mode.. After switch-on, the level of the IQ baseband signals is reduced by 3 dB. In some cases, this might reduce undesired intermodulation products. OFF is normally the more favourable setting. IEC/IEEE-bus command `:SOUR:PDC:LDIS OFF`
TRIGGER MODE...	Opens a window for selecting the trigger mode.	
	AUTO	The PDC signals are continuously transmitted in the activated slots. IEC/IEEE-bus `:SOUR:PDC:SEQ AUTO`
	RETRIG	The PDC signals are continuously transmitted in the activated slots. A trigger event causes a restart. IEC/IEEE-bus `:SOUR:PDC:SEQ RETR`
	ARMED_AUTO	The PDC signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus `:SOUR:PDC:SEQ AAUT`
	ARMED_RETRIG	The PDC signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the RETRIG mode. Each new trigger event causes a restart. IEC/IEEE-bus `:SOUR:PDC:SEQ ARET`

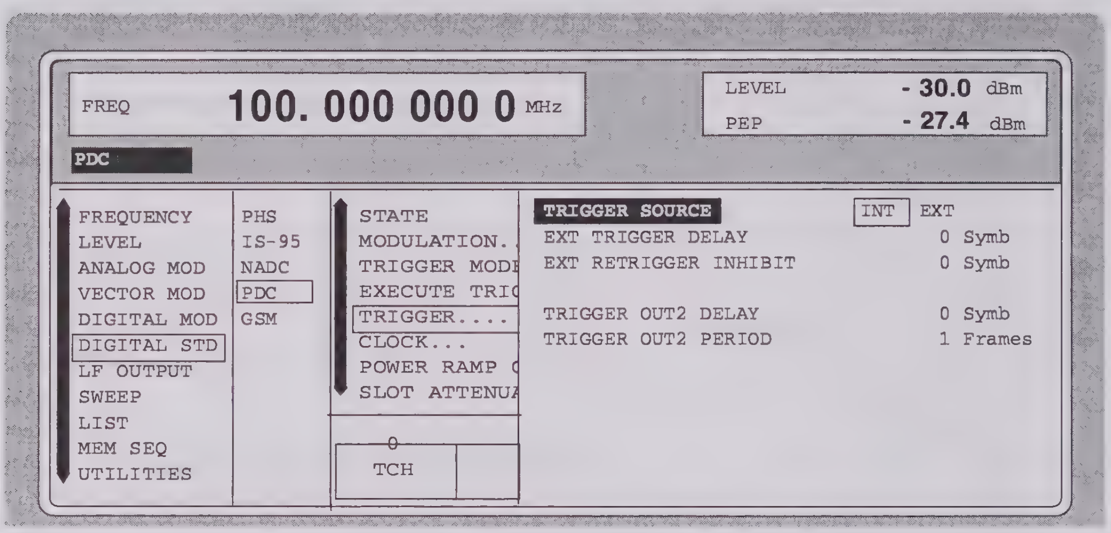
EXECUTE TRIGGER ▶

Executes a trigger even to start the PDC signal generation.

IEC/IEEE-bus command `:TRIG:DM:IMM`

TRIGGER...

Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.



TRIGGER SOURCE INT EXT
EXT TRIGGER DELAY 0 Symb
EXT RETRIGGER INHIBIT 0 Symb
TRIGGER OUT2 DELAY 0 Symb
TRIGGER OUT2 PERIOD 1 Frames

Fig. 2-149 Menu DIGITAL STD - PDC_TRIGGER..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(TRIGGER...)

TRIGGER SOURCE

Selection of trigger source.

EXT The PDC signal generation is started by the active slope of an external trigger signal. The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.

INT A trigger event is executed by EXECUTE TRIGGER ▶.

IEC/IEEE-bus `:SOUR:PDC:TRIG:SOUR EXT`

EXT TRIGGER DELAY

Setting the number of symbols by which an external trigger signal is delayed before it starts the PDC signal generation.
This is used for setting the time synchronization between the SMIQ and the DUT.

IEC/IEEE-bus `:SOUR:PDC:TRIG:DEL 3`

(TRIGGER...)

EXT RETRIGGER INHIBIT

Setting the number of symbols for which a restart is inhibited after a trigger event.
With TRIGGER MODE RETRIG selected, each new trigger signal restarts the PDC signal generation. This restart can be inhibited for the entered number of symbols.

Example:
The entry of 1000 symbols causes new trigger signals to be ignored for the duration of 1000 symbols after a trigger event

IEC/IEEE-bus `:SOUR:PDC:TRIG:INH 1000`

TRIGGER OUT 2 DELAY

Input value of delay of trigger signal at TRIGOUT 2 output compared with beginning of frame.

IEC/IEEE-bus `:SOUR:PDC:TRIG:OUTP:DEL 2`

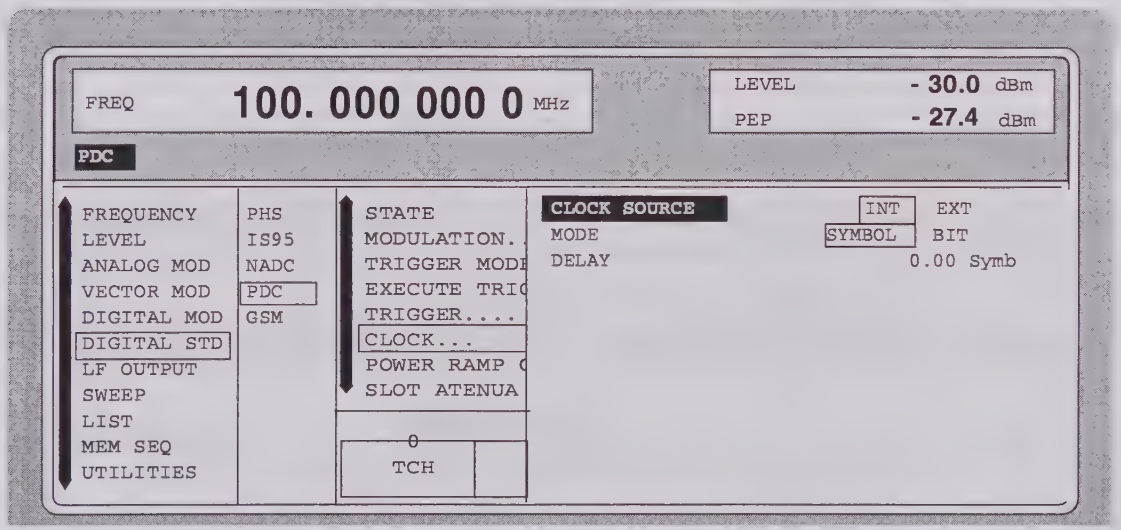
TRIGGER OUT2 PERIOD

Input value of output signal period at TRIGOUT 2 output given in frames.

IEC/IEEE-bus `:SOUR:PDC:TRIG:OUTP:PER 1`

CLOCK...

Opens a window for selecting the clock source and for setting a delay.



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
PEP - 27.4 dBm
CLOCK SOURCE INT EXT
MODE SYMBOL BIT
DELAY 0.00 Symb

Fig. 2-150 Menu DIGITAL STD - PDC - CLOCK..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(CLOCK...)

CLOCK SOURCE Selection of clock source.

INT SMIQ uses internally generated clock signals.

EXT An external symbol clock or bit clock is fed in at connectors SYMBOL CLOCK or BIT CLOCK. The clock synthesizer on the modulation coder is synchronized to this clock.
The symbol rate has to be set with an accuracy of ± 1 %.
The polarity, the trigger threshold and the input resistance of the clock inputs can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus command `:SOUR:PDC:CLOC:SOUR INT`

MODE Selection of clock for external clock signal.

SYMBOL The external clock has to be a symbol clock.

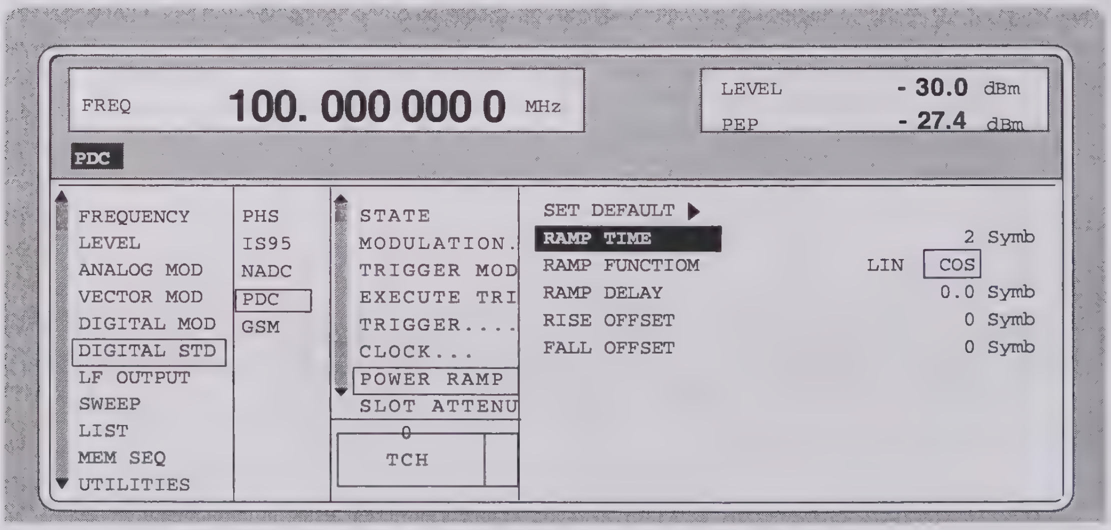
BIT The external clock has to be a bit clock.

IEC/IEEE-bus command `:SOUR:PDC:CLOC:MODE SYMB`

DELAY Setting the delay of generated modulation signal to an external clock.
This can be used, for example, for synchronization with a second unit to achieve time synchronization between the modulation signals of the two units.

IEC/IEEE-bus command `:SOUR:PDC:CLOC:DEL 0.5`

POWER RAMP CONTROL... Opens a window for setting the envelope control, especially for the rising and falling ramp at the beginning and end of a slot.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.4 dBm

RAMP TIME 2 Symb

RAMP FUNCTIOM LIN COS

RAMP DELAY 0.0 Symb

RISE OFFSET 0 Symb

FALL OFFSET 0 Symb

Fig. 2-151 Menu DIGITAL STD - PDC - POWER RAMP CONTROL... , SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(POWER RAMP CONTROL...)	**SET DEFAULT ▶**	Resets the subsequent parameters to the factory-set values. IEC/IEEE-bus `:SOUR:PDC:PRAM:PRES`
	RAMP TIME	Input value for the rise and fall time of the envelope at the beginning or end of a slot. The time is set in units of symbol period. IEC/IEEE-bus `:SOUR:PDC:PRAM:TIME 0.25`
	RAMP FUNCTION	Selection of shape of rising and falling ramp for envelope control. LIN Linear ramp function. COS Cosine function. A more favourable spectrum than that of the LIN function is obtained. IEC/IEEE-bus `:SOUR:PDC:PRAM:SHAP LIN`
	RAMP DELAY	Input value for a shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope. The values are set in the units of the symbol length. IEC/IEEE-bus `:SOUR:PDC:PRAM:DEL 0.1`
	RISE OFFSET	Input value for a positive or negative offset of the rising ramp of the envelope at the beginning of a slot. IEC/IEEE-bus `:SOUR:PDC:PRAM:ROFF -1`
	FALL OFFSET	Input value for a positive or negative offset of the falling ramp of the envelope at the end of a slot. IEC/IEEE-bus `:SOUR:PDC:PRAM:LOFF 1`
SLOT ATTENUATION		Input value for the level reduction in dB of all active slots whose SLOT LEVEL was set to ATTEN. Menu SELECT SLOT allows the slots to be determined whose level is to be reduced. IEC/IEEE-bus command `:SOUR:PDC:SLOT:ATT 15 DB`
SAVE/RCL FRAME...		Opens a window for saving and loading a frame configuration. Loading a frame affects all parameters that can be set under SELECT SLOT.

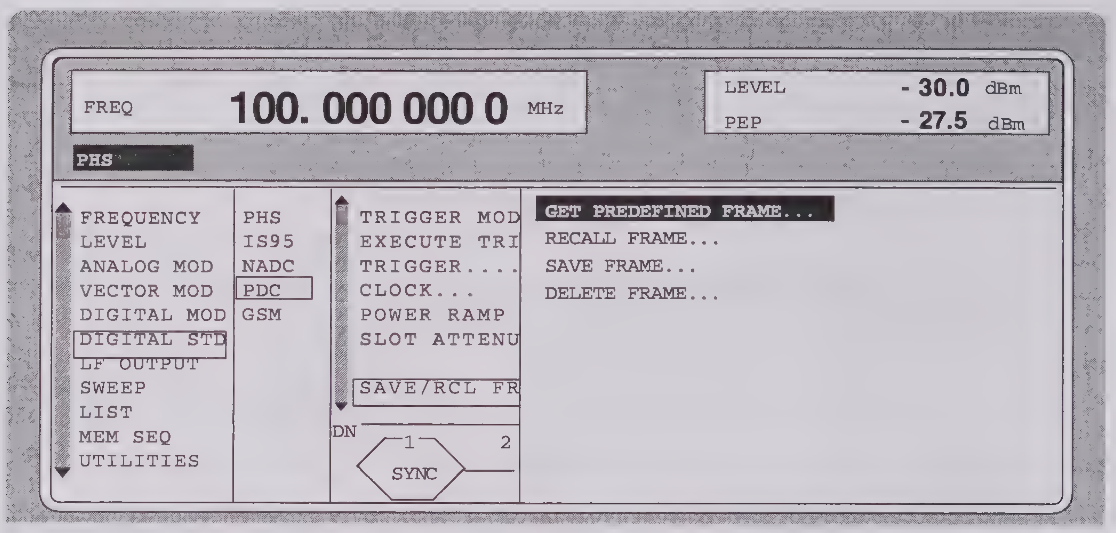


Fig. 2-152 Menu DIGITAL STD - PDC - SAVE/RCL FRAME, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SAVE/RCL FRAME...) **GET PREDEFINED FRAME...** Loads a factory-set frame configuration.

DN_TCH	Downlink traffic channels in all slots.
UP0_TCH	Uplink traffic channels in slot 0

IEEE `:SOUR:PDC:FLIS:PRED:LOAD "dn_tch"`

RECALL FRAME... Loads a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:PDC:FLIS:LOAD "name"`

SAVE FRAME... Saves a user-defined frame configuration.

IEC/IEEE-bus `:SOUR:PDC:FLIS:STOR "name"`

DELETE FRAME... Deletes a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:PDC:FLIS:DEL "name"`

LINK DIRECTION Selection between UPLINK and DOWNLINK. Depending on the selection, different burst types are offered under SELECT SLOT.

IEC/IEEE-bus command `:SOUR:PDC:LINK UP`

RATE CONFIGURATION...

Opens a window for determining which slots in the frame are to be configured as half-rate and full-rate channels. Full-rate channels occupy two slots in a frame, the second slot is fully determined by the configuration of the first slot. The following eight combinations can be selected:

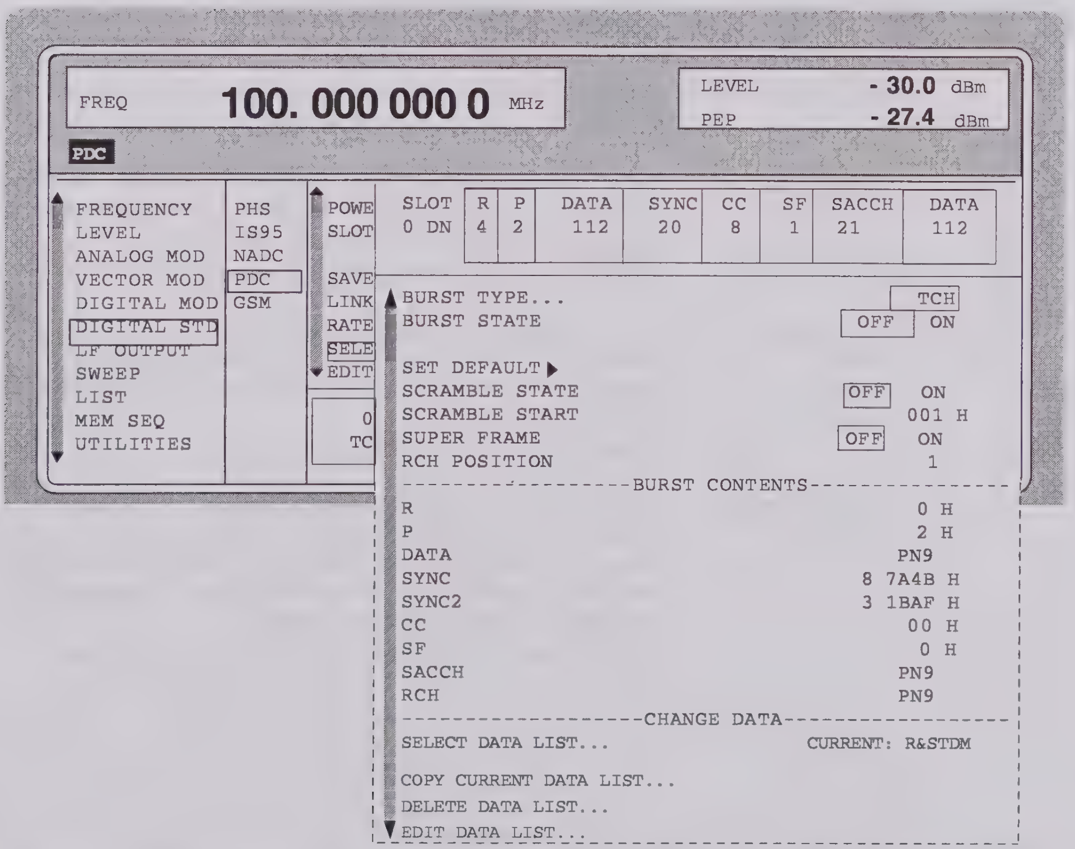
Selection	Full-rate slots	Half-rate slots
ALL HALF	keine	0, 1, 2, 3, 4, 5
FULL 1	0 + 3	1, 2, 4, 5
FULL 2	1 + 4	0, 2, 3, 5
FULL 3	2 + 5	0, 1, 3, 4
FULL 1+2	0 + 3 and 1 + 4	2, 5
FULL 1+3	0 + 3 and 2 + 5	1, 4
FULL 2+3	1 + 4 and 2 + 5	0, 3
ALL FULL	0 + 3 and 1 + 4 and 2 + 5	none

IEC/IEEE-bus command `SOUR:PDC:RCON AHAL`

SELECT SLOT...

Selection of one of 6 possible slots. The number depends on the setting under RATE CONFIGURATION. When selecting the slot, a window is opened in which the data contents belonging to this slot can be defined. The content of the window depends on whether an UPLINK or DOWNLINK was selected under LINK DIRECTION. If the cursor is placed onto a slot in the diagram, it may be switched on and off by pressing one of the unit keys (toggle function).

Menu selection: BURST TYPE = TCH



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.4 dBm

SLOT	R	P	DATA	SYNC	CC	SF	SACCH	DATA
0 DN	4	2	112	20	8	1	21	112

```
BURST TYPE...                              TCH
BURST STATE                          OFF   ON

SET DEFAULT ▶
SCRAMBLE STATE                       OFF   ON
SCRAMBLE START                         001 H
SUPER FRAME                          OFF   ON
RCH POSITION                             1
-----------------BURST CONTENTS---------------
R                                        0 H
P                                        2 H
DATA                                   PN9
SYNC                              8 7A4B H
SYNC2                             3 1BAF H
CC                                      00 H
SF                                       0 H
SACCH                                  PN9
RCH                                    PN9
------------------CHANGE DATA-----------------
SELECT DATA LIST...          CURRENT: R&STDM

COPY CURRENT DATA LIST...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-153 Menu DIGITAL STD - PDC - SELECT SLOT, LINK DIRECTION DOWNLINK, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) TCH

BURST TYPE

Selection of burst type used to configure the selected slot.

TCH Traffic channel burst

IEC/IEEE-bus `:SOUR:PDC:SLOT2:TYPE TCH`

SLOT LEVEL (UPLINK only)

Selection of level for selected slot.

OFF Maximum attenuation
IEC/IEEE `:SOUR:PDC:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.
IEC/IEEE `:SOUR:PDC:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.
IEC/IEEE `:SOUR:PDC:SLOT2:LEV ATT`

BURST STATE (DOWNLINK only)

Substitute for parameter SLOT LEVEL for downlink.

ON The burst contents defined in the data fields are sent in the selected slot.
IEC/IEEE-bus `:SOUR:PDC:SLOT2:LEV FULL`

OFF Only 1s will be sent.
IEC/IEEE-bus `:SOUR:PDC:SLOT2:LEV OFF`

Parameter SLOT LEVEL is omitted since the NADC base station in downlink always sends with the same power in each slot.

SET DEFAULT ▶

Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus command `SOUR:PDC:SLOT8:PRES`

SCRAMBLE

Switch on/off of scrambling function. Scrambling with the continuous scramble sequence from a PN9 generator is applied to the data fields DATA, SF, and SACCH.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SCR:STAT ON`

SCRAMBLE START

9 bit input value for initializing the scramble PN9 generator in hexadecimal form. The value 0 is not permissible, 1 is preset. The input field is only displayed if SCRAMBLE is switched on.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SCR:STAR #H12`

SUPERFRAME

Switch on/off of the superframe generation. 18 frames form a superframe. If SUPERFRAME is switched on, RCH data instead of SACCH data will be sent in 2 slots. The first of the two RCH blocks is fixed in the first slot of the superframe, the position of the second can be set.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SFR:STAT ON`

(SELECT SLOT...) TCH

RCH POSITION

Input value for the position of the second RCH block. The input field is only displayed if SUPERFRAME is switched on.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SFR:RCHP 10`

R

Display of data contents in the 4 bit data field "RAMP" in hexadecimal form.

P

Input value of the 2 bit data field "Preamble".

IEC/IEEE-bus `:SOUR:PDC:SLOT2:PRE #H1`

DATA

Selection of data source for DATA fields. These fields are regarded as a continuous field, ie a pseudo-random sequence is fully continued from one DATA field to the next. The following data sources are available:

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEC/IEEE `:SOUR:PDC:SLOT3:DATA PN15`

DLIST Data from a programmable data list.
IEC/IEEE `:SOUR:PDC:SLOT3:DATA DLIS`

SERDATA Data from data input SER DATA.
IEC/IEEE `:SOUR:PDC:SLOT3:DATA SDAT`

SYNC

Input value for the 20 bit sync word in hexadecimal form. Depending on the selected slot the LINK DIRECTION, the following sync words are predefined according to the PDC standard:

Slot No.	Downlink Sync Word	Uplink Sync Word
0	87A4B	785B4
1	9D236	62DC9
2	81D75	7E28A
3	A94EA	56B15
4	5164C	AE9B3
5	4D9DE	B2621

According to the standard, the sync words of the uplink are the inverted sync words of the downlink.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SYNC #H62DC8`

(SELECT SLOT...) TCH **SYNC2**

Input value for the 20 bit sync word in the first slot of a superframe in hexadecimal form. This sync word marks the beginning of the superframe. The input field is only displayed if SUPERFRAME is switched on. Depending on the selected slot and the LINK DIRECTION, the following sync words are predefined according to the PDC standard:

Slot No.	Downlink Sync2 Word	Uplink Sync2 Word
0	31BAF	CE450
1	1E56F	E1A90
2	E712C	18ED3
3	FBC1F	043E0
4	8279E	7D861
5	98908	676F7

According to the standard, the sync words of the uplink are the inverted sync words of the downlink.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SYNC #HE2A90`

CC

Input value of the 8 bit data field " Color code ".

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:CCOD #HFF`

SF

Input value of the data field " Steal Flag ".

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:SF #H0`

SACCH

Selection of data source for SACCH field (Slow Associated Control Channel).

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEC/IEEE `:SOUR:PDC:SLOT3:SACC PN15`

DLIST Data from a programmable data list.
IEC/IEEE `:SOUR:PDC:SLOT3:SACC DLIS`

SERDATA Data from data input SER DATA.
IEC/IEEE `:SOUR:PDC:SLOT3:SACC SDAT`

RCH

Selection of data source for the RCH data field. RCH data replace SACCH data in certain slots of a superframe. The input field is only displayed if SUPERFRAME is switched on.

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEC/IEEE `:SOUR:PDC:SLOT3:RCH PN15`

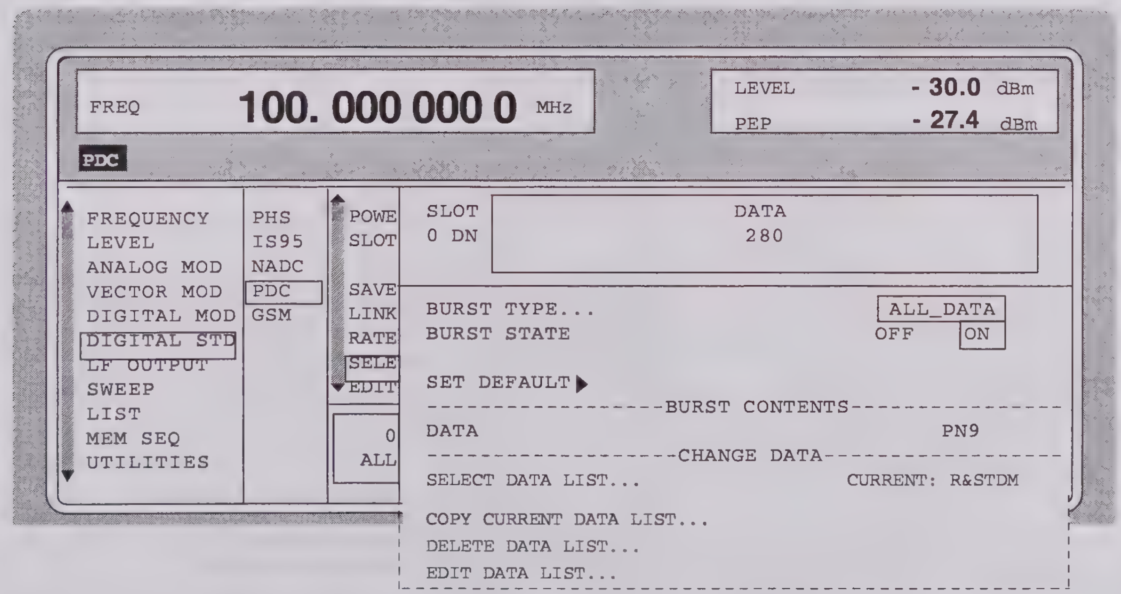
DLIST Data from a programmable data list.
IEC/IEEE `:SOUR:PDC:SLOT3:RCH DLIS`

SERDATA Data from data input SER DATA.
IEC/IEEE `:SOUR:PDC:SLOT3:RCH SDAT`

(SELECT SLOT...) TCH	**G** (UPLINK only)	Display of data content in the 6 bit "Guard" field in hexadecimal form.
	SELECT DATA LIST...	Opens a window for selecting a stored data list or for generating a new list.
	COPY CURRENT DATA LIST TO...	Stores the current data list under a different name.
	DELETE DATA LIST...	Deletes a data list.
	EDIT DATA LIST...	Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

Menu selection: BURST TYPE = ALL_DATA


FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 27.4 dBm

SLOT 0 DN

DATA 280

BURST TYPE... ALL_DATA

BURST STATE OFF ON

SET DEFAULT ▶

BURST CONTENTS

DATA PN9

CHANGE DATA

SELECT DATA LIST... CURRENT: R&STDM

COPY CURRENT DATA LIST...

DELETE DATA LIST...

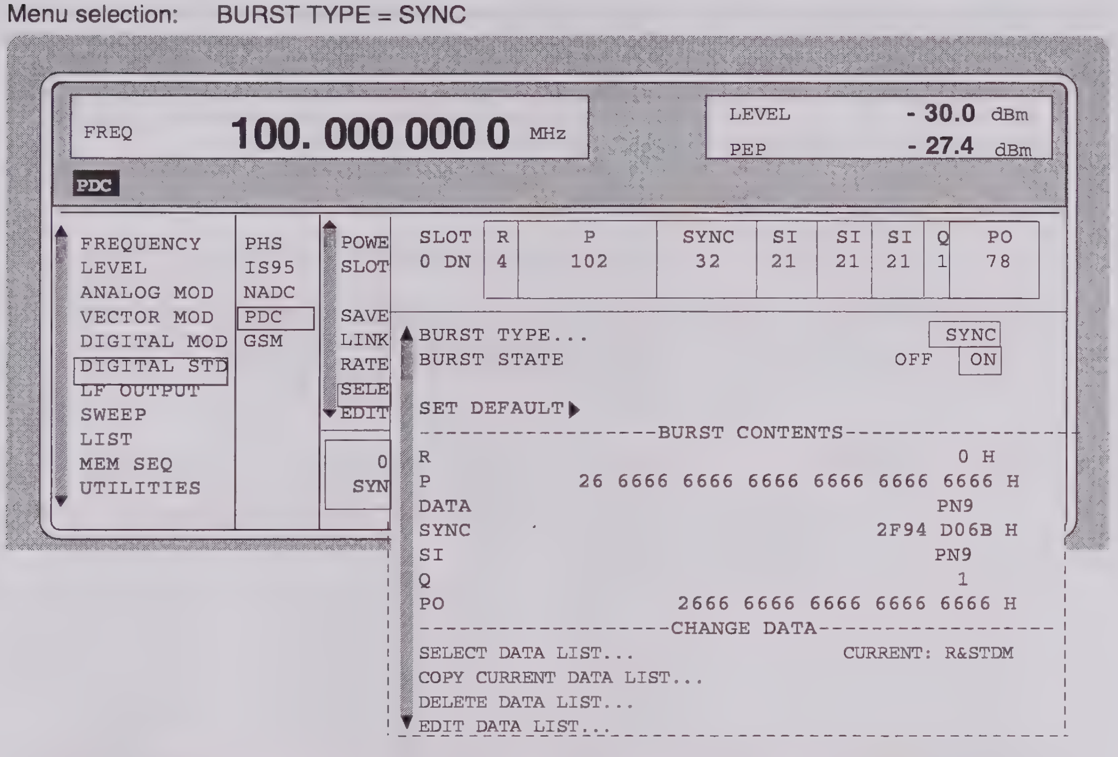
EDIT DATA LIST...

Fig. 2-154 Menu DIGITAL STD - PDC - SELECT SLOT, LINK DIRECTION = DOWNLINK, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) **ALL_DATA**	**BURST TYPE**	Selection of burst type used to configure the selected slot. ALL DATA Burst type for testing with freely programmable data contents IEC/IEEE-bus command `:SOUR:PDC:SLOT2:TYPE ADAT`
	SLOT LEVEL (UPLINK only)	Selection of level for selected slot. OFF Maximum attenuation IEC/IEEE `:SOUR:PDC:SLOT2:LEV OFF` FULL The level corresponds to the value indicated on the SMIQ LEVEL display. IEC/IEEE `:SOUR:PDC:SLOT2:LEV FULL` ATTEN The level is reduced by the value set under SLOT ATTENUATION. IEC/IEEE `:SOUR:PDC:SLOT2:LEV ATT`
	BURST STATE (DOWNLINK only)	Substitute for parameter SLOT LEVEL for downlink. ON The burst contents defined in the data fields are sent in the selected slot. IEC/IEEE-bus `:SOUR:PDC:SLOT2:LEV FULL` OFF Only 1s will be sent. IEC/IEEE-bus `:SOUR:PDC:SLOT2:LEV OFF` Parameter SLOT LEVEL is omitted since the NADC base station in downlink always sends with the same power in each slot.
	R (UPLINK only)	Display of data contents in the 6 bit data field "Ramp" in hexadecimal form..
	G (UPLINK only)	Display of data contents in the 6 bit data field "Guard" in hexadecimal form.
	DATA	Selection of data source for DATA fields. These fields are regarded as a continuous field, ie a pseudo-random sequence is fully continued from one DATA field to the next. The following data sources are available: PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1. IEC/IEEE `:SOUR:PDC:SLOT3:DATA PN15` DLIST Data from a programmable data list. IEC/IEEE `:SOUR:PDC:SLOT3:DATA DLIS` SERDATA Data from data input SER DATA. IEC/IEEE `:SOUR:PDC:SLOT3:DATA SDAT`

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see menu selection BURST TYPE = TCH

Menu selection: BURST TYPE = SYNC



```
FREQ   100. 000 000 0  MHz          LEVEL  - 30.0 dBm
                                    PEP    - 27.4 dBm

SLOT  | R |  P  | SYNC | SI | SI | SI | Q | PO
0 DN  | 4 | 102 |  32  | 21 | 21 | 21 | 1 | 78

BURST TYPE...                                        SYNC
BURST STATE                                     OFF  ON

SET DEFAULT
------------------BURST CONTENTS------------------
R                                                   0 H
P              26 6666 6666 6666 6666 6666 6666 H
DATA                                               PN9
SYNC                                        2F94 D06B H
SI                                                 PN9
Q                                                    1
PO                    2666 6666 6666 6666 6666 H
------------------CHANGE DATA------------------
SELECT DATA LIST...                    CURRENT: R&STDM
COPY CURRENT DATA LIST...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-155 Menu DIGITAL STD - PDC - SELECT SLOT, LINK DIRECTION = DOWNLINK, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) SYNC

BURST TYPE

Selection of burst type used to configure the selected slot.

SHORT Shortened Burst

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:TYPE SYNC`

SLOT LEVEL (UPLINK only)

Selection of level for selected slot.

OFF Maximum attenuation

IEC/IEEE `:SOUR:PDC:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.

IEC/IEEE `:SOUR:PDC:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.

IEC/IEEE `:SOUR:PDC:SLOT2:LEV ATT`

BURST STATE (DOWNLINK only)

Substitute for parameter SLOT LEVEL for downlink.

ON The burst contents defined in the data fields are sent in the selected slot.

OFF Only 1s will be sent.

Parameter SLOT LEVEL is omitted since the PDC base station in downlink always sends with the same power in each slot.

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:LEV FULL`

(SELECT SLOT...) SYNC

SET DEFAULT ▶ Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus command `:SOUR:PDC:SLOT8 PRES`

G (UPLINK only) Display of data contents in the 54 bit data field "Guard" in hexadecimal form.

The field is only displayed with link direction UPLINK selected.

R Display of data contents in the 6 bit data field "Ramp".

P Input value of the data field "Preamble" in hexadecimal form.The length of the field is 48 bit with link direction = UPLINK, and 102 bit with DOWNLINK

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:PRE #HFF`

SYNC Input value for the 32 bit sync word in hexadecimal form. Depending on the selected slot and the link direction, the following sync words are predefined according to the PDC standard:

Slot No.	Downlink Sync Word	Uplink Sync Word
0	2F94D06B	D06B2F94
1	1D4EE2B1	E2B11D4E
2	70168FE9	8FE97016
3	83527CAD	7CAD8352
4	3678C987	C9873678
5	48D8B727	B72748D8

According to the standard, the sync words of the uplink are the inverted sync words of the downlink.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SYNC #HE2B11D4F`

SI Selection of data source for "Sync Information" field. The data in each of the three SI fields are identical

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.

IEC/IEEE `:SOUR:PDC:SLOT2:SOUR:SI PN15`

DLIST Data from a programmable data list.

IEC/IEEE `:SOUR:PDC:SLOT2:SOUR:SI DLIS`

SERDATA Data from data input SER DATA.

IEC/IEEE `:SOUR:PDC:SLOT2:SOUR:SI SDAT`

Q Display of the tail bits.

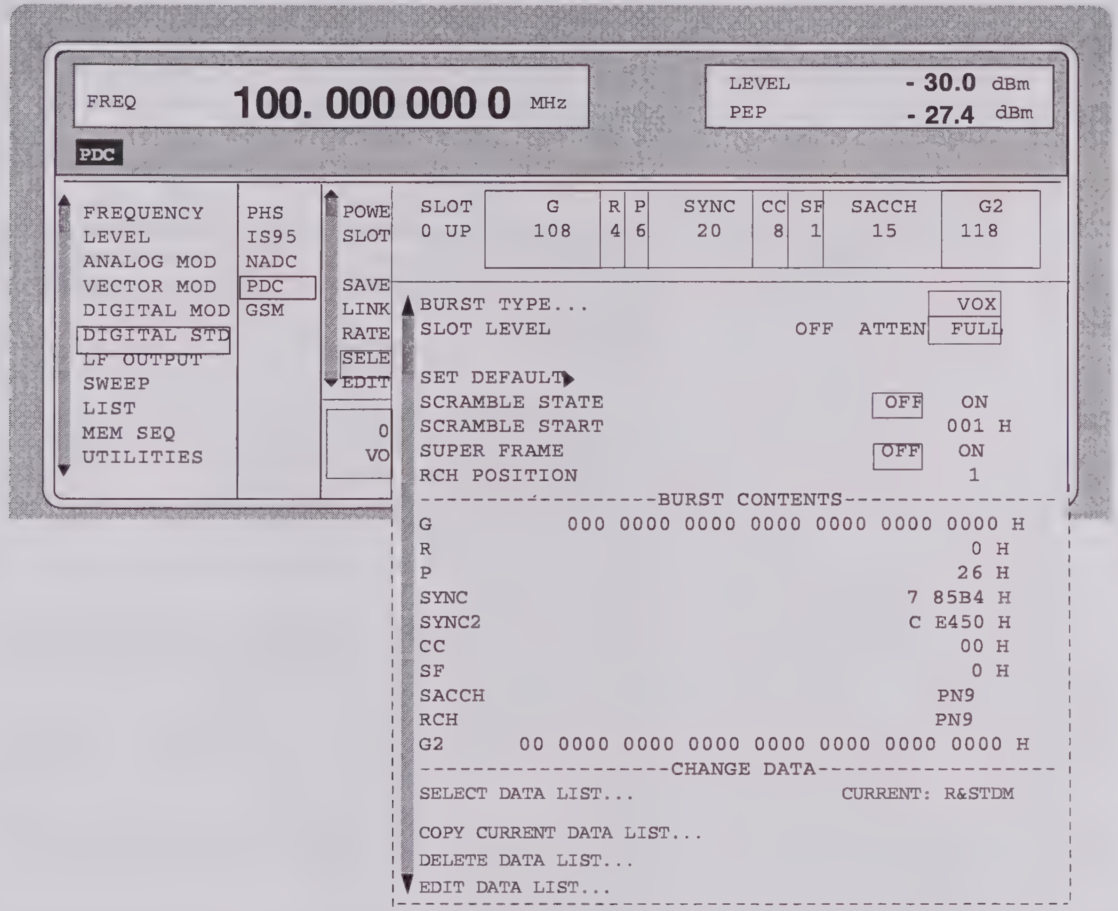
PO (DOWNLINK only) Input value for the 78 bit "Postamble" field in hexadecimal form.

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:POST #HFF`

G2 (UPLINK only) Display of data contents in the 78 bit "Guard" field in hexadecimal form at the end of the slot.

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see menu selection BURST TYPE = TCH

Menu selection: BURST TYPE = VOX (only available with LINK DIRECTION = UPLINK)



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm
PEP - 27.4 dBm

SLOT	G	R	P	SYNC	CC	SF	SACCH	G2
0 UP	108	4	6	20	8	1	15	118

```
BURST TYPE...                              VOX
SLOT LEVEL                  OFF   ATTEN   FULL

SET DEFAULT
SCRAMBLE STATE                     OFF    ON
SCRAMBLE START                         001 H
SUPER FRAME                        OFF    ON
RCH POSITION                               1
------------------BURST CONTENTS-----------------
G          000 0000 0000 0000 0000 0000 0000 H
R                                          0 H
P                                         26 H
SYNC                                  7 85B4 H
SYNC2                                 C E450 H
CC                                        00 H
SF                                         0 H
SACCH                                     PN9
RCH                                       PN9
G2      00 0000 0000 0000 0000 0000 0000 0000 H
-------------------CHANGE DATA-------------------
SELECT DATA LIST...           CURRENT: R&STDM

COPY CURRENT DATA LIST...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-156 Menu DIGITAL STD - PDC - SELECT SLOT, LINK DIRECTION = UPLINK, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) VOX
(UPLINK ONLY)

BURST TYPE

Selection of burst type used to configure the selected slot. VOX is only available with LINK DIRECTION = UPLINK selected.

VOX	VOX burst

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:TYPE VOX`

SLOT LEVEL

Selection of level for selected slot.

OFF	Maximum attenuation IEC/IEEE `:SOUR:PDC:SLOT2:LEV OFF`
FULL	The level corresponds to the value indicated on the SMIQ LEVEL display. IEC/IEEE `:SOUR:PDC:SLOT2:LEV FULL`
ATTEN	The level is reduced by the value set under SLOT ATTENUATION. IEC/IEEE `:SOUR:PDC:SLOT2:LEV ATT`

(SELECT SLOT...) VOX (UPLINK ONLY)

SET DEFAULT ▶ Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus command `SOUR:PDC:SLOT8 PRES`

SCRAMBLE Switch on/off of scrambling function. Scrambling with the continuous scramble sequence from a PN9 generator is applied to the data fields SF and SACCH.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SCR:STAT ON`

SCRAMBLE START 9 bit input value for initializing the scramble PN9 generator in hexadecimal form. The value 0 is not permissible, 1 is preset. The input field is only displayed if SCRAMBLE is switched on.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SCR:STAR #H2`

SUPERFRAME Switch on/off of the superframe generation. 18 frames form a superframe. If SUPERFRAME is switched on, RCH data instead of SACCH data will be sent in 2 slots. The first of the two RCH blocks is fixed in the first slot of the superframe, the position of the second can be set.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SFR:STAT ON`

RCH POSITION Input value for the position of the second RCH block. The input field is only displayed if SUPERFRAME is switched on.

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SFR:RCHP 10`

G Display of data contents in the 108 bit "Guard" field at the beginning of the slot in hexadecimal form.

R Display of data contents in the 4 bit data field "RAMP" in hexadecimal form.

P Input value of the 26 bit data field "Preamble".

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:PRE #HFF`

SYNC Input value for the 20 bit sync word in hexadecimal form. Depending on the selected slot, the following sync words are predefined according to the PDC standard:

Slot No.	VOX Sync Word
0	785B4
1	62DC9
2	7E28A
3	56B15
4	AE9B3
5	B2621

IEC/IEEE-bus `:SOUR:PDC:SLOT2:SYNC #H72DC9`

(SELECT SLOT...) VOX
(UPLINK ONLY)

SYNC2

Input value for the 20 bit sync word in the first slot of a superframe in hexadecimal form. This sync word marks the beginning of a superframe. The input field is only displayed if SUPERFRAME is switched on. Depending on the selected slot, the following sync words are predefined according to the PDC standard:

Slot No.	VOX Sync2 Word
0	CE450
1	E1A90
2	18ED3
3	043E0
4	7D861

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:SYNC E1A91`

CC

Input value of the 8 bit data field " Color code ".

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:CCOD #HFF`

SF

Input value of the data field " Steal Flag ".

IEC/IEEE-bus command `:SOUR:PDC:SLOT2:SF #H0`

SACCH

Selection of data source for SACCH field (Slow Associated Control Channel).

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEC/IEEE `:SOUR:PDC:SLOT3:SACC PN15`

DLIST Data from a programmable data list.
IEC/IEEE `:SOUR:PDC:SLOT3:SACC DLIS`

SERDATA Data from data input SER DATA.
IEC/IEEE `:SOUR:PDC:SLOT3:SACC SDAT`

RCH

Selection of data source for the RCH data field. RCH data replace SACCH data in certain slots of a superframe. The input field is only displayed if SUPERFRAME is switched on.

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEC/IEEE `:SOUR:PDC:SLOT3:SOUR:RCH PN9`

DLIST Data from a programmable data list.
IEC/IEEE `:SOUR:PDC:SLOT3:SOUR:RCH DLIS`

SERDATA Data from data input SER DATA.
IEC/IEEE `:SOUR:PDC:SLOT3:SOUR:RCH SDAT`

G2

Display of data contents in the 118 bit "Guard" field at the end of the slot in hexadecimal form. The field is only displayed with LINK DIRECTION = UPLINK selected.

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see menu selection BURST TYPE = TCH

2.17 Digital Standard GSM

With the options Modulation Coder (SMIQB20) and Data Generator (SMIQB11) provided, modulation signals according to the GSM standard an be generated. GSM is a TDMA standard for cellular mobile radio networks used worldwide. SMIQ is suitable for use as a signal generator for all GSM types.

SMIQ can generate both the transmit signal of a base station (BS) and the transmit signal of a mobile station (MS). Transmission from BS to MS is called "downlink", "uplink" being used for transmission in the opposite direction.

Each TDMA frame consists of 8 slots. Each slot can be switched on or off separately. Moreover, a defined intermediate level can be set.

A burst type has to be defined to configure a slot. The following burst types can be selected:

• NORM	the so-called "normal burst",
• DUMMY	burst type with a defined data pattern according to GSM standard and
• ALL_DATA	burst type for test purposes with freely programmable data contents.

The following internal modulation sources are available:

- different PRBS generators with a sequence length between 2^9-1 and 2^{23}-1 and
- data lists, ie freely programmable data sequences from the data generator memory.

For generating the GSM signals, SMIQ inserts the modulation data continuously (in real time) into the selected slots. Using a digital signal processor the data generator generates a data sequence with modulation data and control signals for envelope control.

The data generator in SMIQ generates a data stream which is converted into IQ signals in the modulation coder. According to the GSM standard, the modulation type is GMSK at a symbol rate of 270.833 ksymbol/s and Gauss filtering. The symbol rate can be changed in SMIQ. GFSK with adjustable frequency deviation can be used as a modulation type, too.

2.17.1 Sync and Trigger Signals

The data generator generates a data sequence with modulation data, control signals for envelope control, and synchronization signals.

When TRIGGER MODE AUTO is selected, the GSM signal generation is started automatically.

This start can also be activated by an external trigger signal (TRIGGER MODE ARMED_AUTO) which allows a synchronous sequence for BER measurements to be carried out on receivers.

A trigger signal can be fed via the TRIGIN input at connector PAR DATA. The active slope of a trigger signal applied there executes a trigger event.
GSM signal generation at a frame limit is started after a trigger event. Data from data lists are inserted into the selected slots starting from the first bit. PRBS generators start with the set initialization status.

Signal generation either starts immediately after the active slope of the trigger signal or after a settable number of symbols (EXT TRIGGER DELAY). Retriggering (EXT RETRIG) can be inhibited for a settable number of symbols (EXT RETRIGGER INHIBIT).

A trigger event can be executed manually using EXECUTE TRIGGER or via the IEC/IEEE bus.

When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ also generates the following sync signals:

- a frame clock at TRIGOUT 1 output,
- a frame or multiframe clock at TRIGOUT 2 output with settable position in the frame,
- the symbol clock and the bit clock.

A clock synthesizer on the modulation coder generates the symbol clock and the bit clock in SMIQ. The two clocks are identical for GSM. All the clock signals are synchronized to the 10-MHz reference of SMIQ. The bit clock is available at connector BIT CLOCK. If required, the clock synthesizer in SMIQ can be synchronized to an external bit clock.

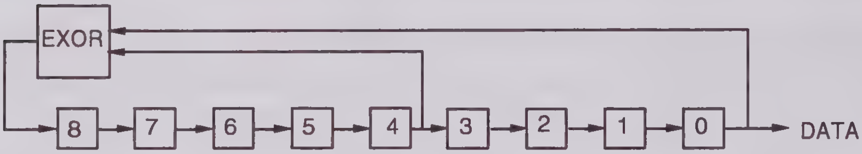
The clock signal is selected in the menu via CLOCK-CLOCK SOURCE EXT.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Note: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.17.2 PN Generators as Internal Data Source

Independent PN generators (Pseudo Noise) can be selected for each slot as data source for data field DATA. These PN generators provide pseudo-random bit sequences of different length or period. That is why they are also called PRBS generators (Pseudo Random Binary Sequence).
Data sequences are sequences of maximum length which are generated by means of feedback shift registers.
The following figure gives an example of a 9 bit generator with feedbacks after register 4 and 0 (output).



The pseudo-random sequence of a PRBS generator is clearly defined by the number of registers and the feedback. The following table describes all PRBS generators available:

Table 2-34 PRBS generators for GSM

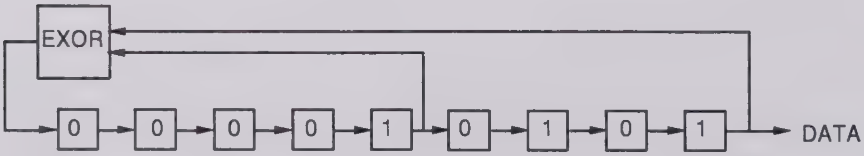
PRBS generator	**Length in bits**	**Feedback after**
9 bit	2^{9} -1 = 511	Register 4, 0
11 bit	2^{11} -1 =2047	Register 2, 0
15 bit	2^{15} -1 = 32767	Register 1, 0
16 bit	2^{16} -1 = 65535	Register 5, 3, 2, 0
20 bit	2^{20} -1 = 1048575	Register 3, 0
21 bit	2^{21} -1 = 2097151	Register 2, 0
23 bit	2^{23} -1 = 8388607	Register 5, 0

PN generators PN9,11,15, 20 and PN23 are configured according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generators PN15 and PN23.

The start value of the PN generators is different in the slots and equals

$$\text{start value} = 1 + 14\,\text{hex} \times \text{slot number}$$

Example: PN9 generator in slot 1 with start value 15hex = 10101 binary.



The resulting output sequence is `1010100000010100101011110010` etc.

2.17.3 Lists as Internal Data Source

A freely programmable memory on the data generator serves as internal data source for the data fields of the slots. The data are managed in so-called lists. A list editor allows to select, copy, modify and delete data lists (DATA LIST).
The list editor is available via menu DIGITAL-MOD - SOURCE....

2.17.4 External Modulation Data

External data can (only) be applied via the SERDATA interface. A selection of SERDATA as data source is only possible for a single data field of a slot. For further information on the characteristics of the SERDATA interface see Annex A.

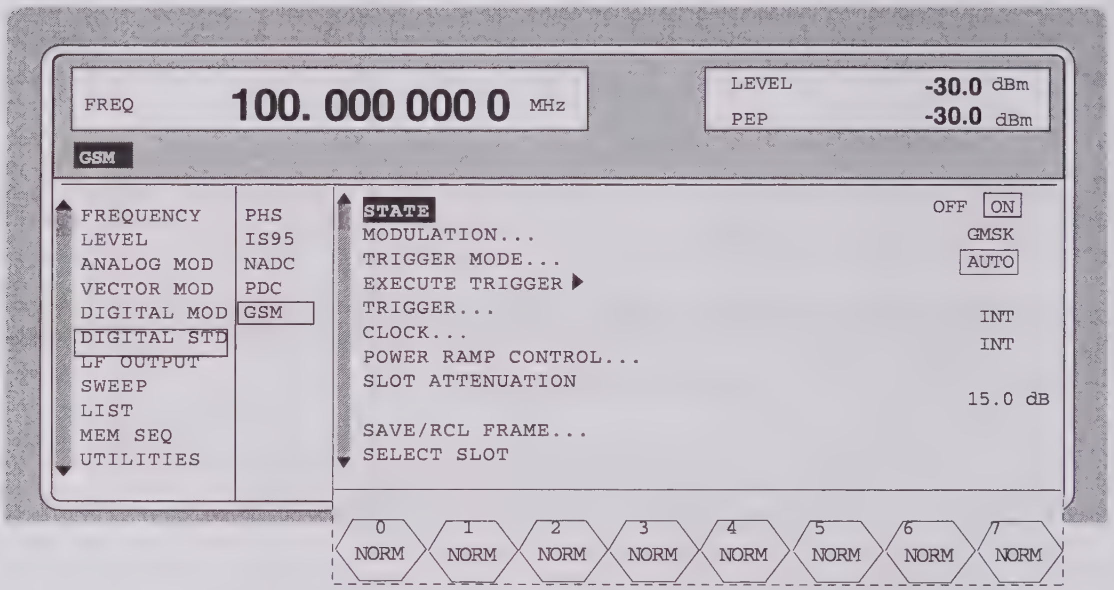
To ensure that the external data bits are assigned to specific positions in the data field of the selected slot and that they are reproducible, the buffer of the RS-232 transmitter and receiver has to be deleted. A triggered start has to follow.
The following setting sequence is required in the DIGITAL STD - GSM menu:

1. Carry out desired settings in menu.
2. Select data source SERDATA for the data field of the slot using SELECT SLOT - ....
3. Make connection to external data source, but do not yet start external data source.
4. Switch off digital standard using STATE - OFF.
5. Set TRIGGER MODE ARMED_AUTO.
   In this state, SMIQ is ready for reception, but discards data that are read in via SERDATA.
6. Switch on digital standard with STATE ON.
7. Start external data source.
   The read-in data are written into the receiving buffer. Only if this buffer is filled can SMIQ react to a trigger event.
8. Activate trigger event. Signal generation is thus started at a frame limit. The first bit received via SERDATA is put to the first bit position in the selected data field.

2.17.5 Menu DIGITAL STANDARD - GSM

Menu DIGITAL STD - GSM provides access to settings for generating GSM signals.

Menu selection: DIGITAL STD - GSM


FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

PEP -30.0 dBm

STATE OFF ON

MODULATION... GMSK

TRIGGER MODE... AUTO

TRIGGER... INT

CLOCK... INT

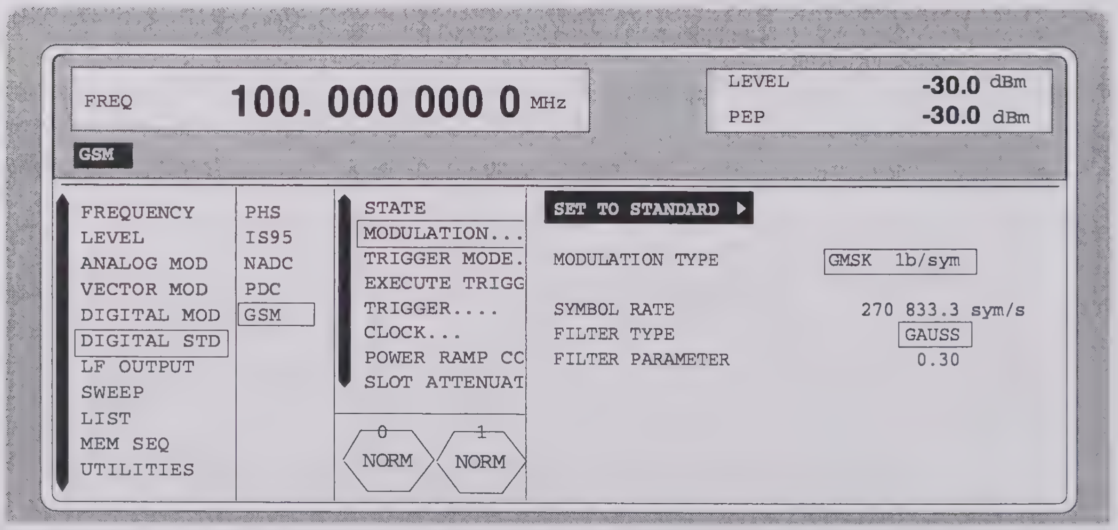
SLOT ATTENUATION 15.0 dB

Fig. 2-157 Menu DIGITAL STD - GSM, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

STATE Switch on/off of Digital Standard GSM modulation. Vector Modulation or Digital Modulation will be switched off automatically.

IEC/IEEE-bus command `SOUR:GSM:STAT ON`

MODULATION... Opens a window for setting the modulation parameters.


FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

PEP -30.0 dBm

MODULATION TYPE GMSK 1b/sym

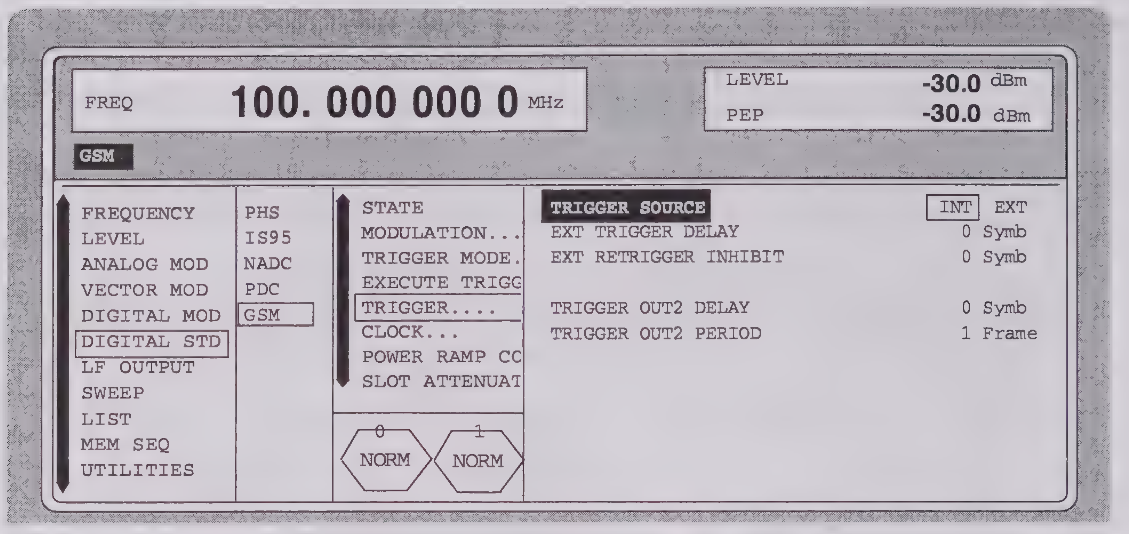
SYMBOL RATE 270 833.3 sym/s

FILTER TYPE GAUSS

FILTER PARAMETER 0.30

Fig. 2-158 Menu DIGITAL STD - GSM - MODULATION..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(MODULATION...)	**SET TO STANDARD ▶**	Sets the subsequent modulation parameters to the values predefined by the standard.
	MODULATION TYPE	Opens a window for selection of the modulation type. GMSK Gaussian Minimum Shift Keying GFSK Gaussian filtered Frequency Shift Keying IEC/IEEE-bus `SOUR:GSM:FORMat GMSK`
	FSK DEVIATION	Input value of deviation with GFSK selected. With GMSK selected, the deviation is fixed to the fourth part of the symbol rate. IEC/IEEE-bus `SOUR:GSM:FSK:DEV 67 KHZ`
	SYMBOL RATE	Input value for the symbol clock. 270.833 ksymbol/s are preset. IEC/IEEE-bus `SOUR:GSM:SRAT 270KHZ`
	FILTER	Display of the baseband filter.
	FILTER PARAMETER	Input value for the B×T value (Gaussian filter). IEC/IEEE-bus `SOUR:GSM:FILT:PAR 0.31`
TRIGGER MODE...	Opens a window for selecting the trigger mode.	
	AUTO	The GSM signals are continuously transmitted in the activated slots. IEC/IEEE-bus command `SOUR:GSM:SEQ AUTO`
	RETRIG	The GSM signals are continuously transmitted in the activated slots. A trigger event causes a restart. IEC/IEEE-bus command `SOUR:GSM:SEQ RETR`
	ARMED_AUTO	The GSM signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus command `SOUR:GSM:SEQ AAUT`
	ARMED_RETRIG	The GSM signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the RETRIG mode. Each new trigger event causes a restart. IEC/IEEE-bus command `SOUR:GSM:SEQ ARET`
EXECUTE TRIGGER ▶	Executes a trigger even to start the GSM signal generation. IEC/IEEE-bus command `:TRIG:DM:IMM`	
TRIGGER...	Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.	



FREQ 100. 000 000 0 MHz
LEVEL -30.0 dBm
PEP -30.0 dBm

TRIGGER SOURCE INT EXT
EXT TRIGGER DELAY 0 Symb
EXT RETRIGGER INHIBIT 0 Symb
TRIGGER OUT2 DELAY 0 Symb
TRIGGER OUT2 PERIOD 1 Frame

Fig. 2-159 Menu DIGITAL STD - GSM_TRIGGER..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(TRIGGER...)

TRIGGER SOURCE

Selection of trigger source.

EXT	The GSM signal generation is started by the active slope of an external trigger signal. The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.
INT	A trigger event can be executed by EXECUTE TRIGGER ▶.

IEC/IEEE-bus `SOUR:GSM:TRIG:SOUR EXT`

EXT TRIGGER DELAY

Setting the number of symbols by which an external trigger signal is delayed before it starts the GSM signal generation.
This is used for setting the time synchronization between the the SMIQ and the DUT.

IEC/IEEE-bus `SOUR:GSM:TRIG:DEL 3`

EXT RETRIGGER INHIBIT

Setting the number of symbols for which a restart is inhibited after a trigger event.
With TRIGGER MODE RETRIG selected, each new trigger signal restarts the GSM signal generation. This restart can be inhibited for the entered number of symbols.

Example:
The entry of 1000 symbols causes new trigger signals to be ignored for the duration of 1000 symbols after a trigger event

IEC/IEEE-bus `SOUR:GSM:TRIG:INH 1000`

(TRIGGER...)

TRIGGER OUT2 DELAY

Input value of delay of trigger signal at TRIGOUT 2 output compared with beginning of frame.

IEC/IEEE-bus `SOUR:GSM:TRIG:OUTP:DEL 2`

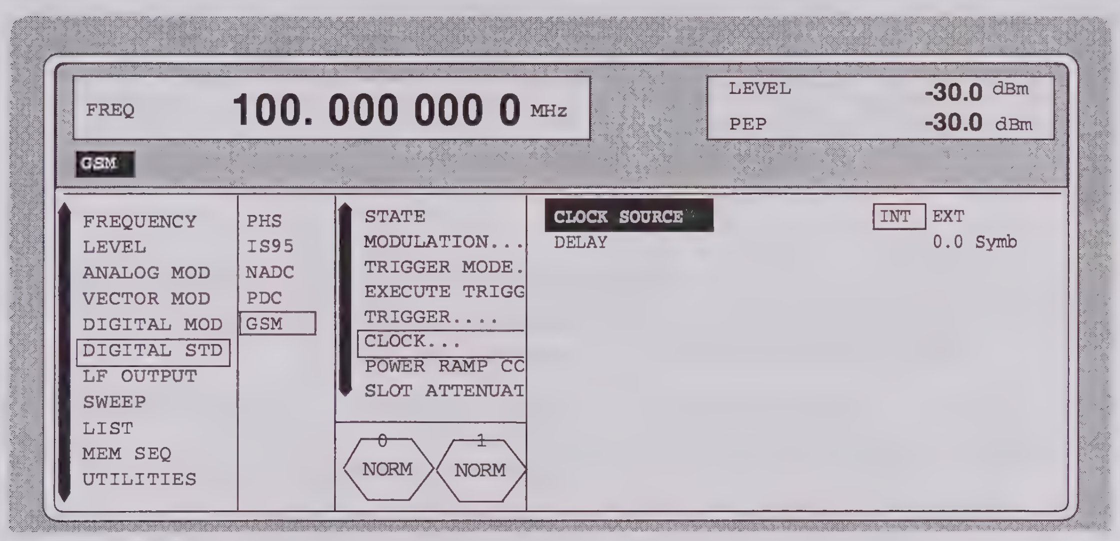
TRIGGER OUT2 PERIOD

Input value of output signal period at TRIGOUT 2 output given in frames.

IEC/IEEE-bus `SOUR:GSM:TRIG:OUTP:PER 1`

CLOCK...

Opens a window for selecting the clock source and for setting a delay.



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

PEP -30.0 dBm

CLOCK SOURCE INT EXT

DELAY 0.0 Symb

Fig. 2-160 Menu DIGITAL STD - GSM - CLOCK..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(CLOCK...)

CLOCK SOURCE

Selection of clock source.

INT	SMIQ uses internally generated clock signals.
EXT	An external bit clock is fed in at connector BIT CLOCK. The clock synthesizer on the modulation coder is synchronized to this clock. The symbol rate has to be set with an accuracy of ± 1 %. The polarity, the trigger threshold and the input resistance of the clock inputs can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus `SOUR:GSM:CLOC:SOUR INT`

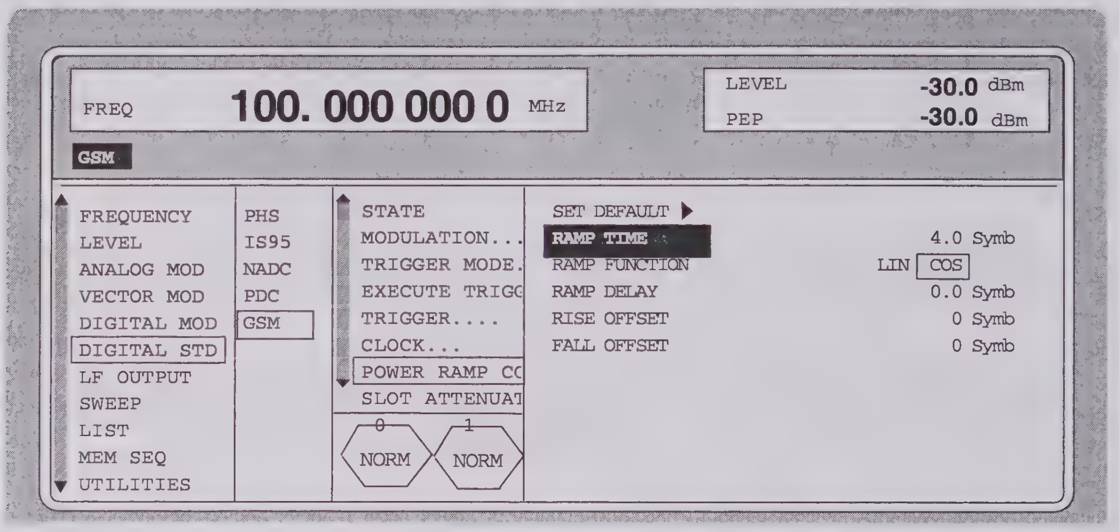
DELAY

Setting the delay of generated modulation signal to an external clock.

This can be used, for example, for synchronization with a second unit to achieve time synchronization between the modulation signals of the two units.

IEC/IEEE-bus `SOUR:GSM:CLOC:DEL 0.5`

POWER RAMP CONTROL... Opens a window for setting the envelope control, especially for the rising and falling ramp at the beginning and end of a slot.



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

PEP -30.0 dBm

RAMP TIME 4.0 Symb

RAMP FUNCTION LIN COS

RAMP DELAY 0.0 Symb

RISE OFFSET 0 Symb

FALL OFFSET 0 Symb

Fig. 2-161 Menu DIGITAL STD - GSM - POWER RAMP CONTROL... , SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(POWER RAMP CONTROL...)

SET DEFAULT ▶ Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus `:SOUR:GSM:PRAM:PRES`

RAMP TIME Input value for the rise and fall time of the envelope at the beginning or end of a slot. The time is set in units of symbol period.

IEC/IEEE-bus `SOUR:GSM:PRAM:TIME 2.5`

RAMP FUNCTION Selection of shape of rising and falling ramp for envelope control.

LIN	Linear ramp function.
COS	Cosine function. A more favourable spectrum than that of the LIN function is obtained.

IEC/IEEE-bus `SOUR:GSM:PRAM:SHAP LIN`

RAMP DELAY Input value for a shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope. The values are set in the units of the symbol length.

IEC/IEEE-bus `SOUR:GSM:PRAM:DEL 0.1`

RISE OFFSET Input value for a positive or negative offset of the rising ramp of the envelope at the beginning of a slot.

IEC/IEEE-bus `SOUR:GSM:PRAM:ROFF -1`

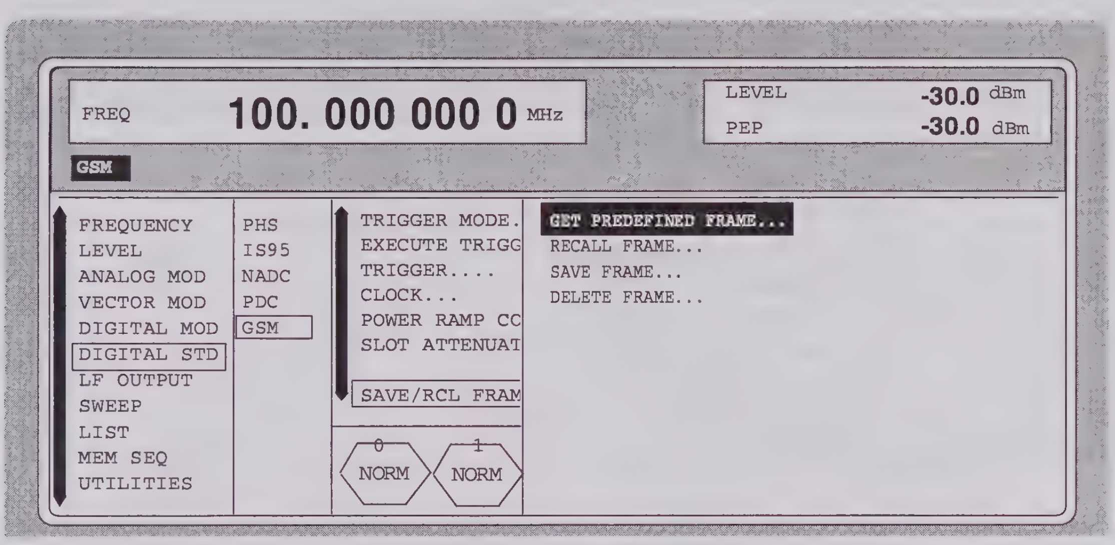
FALL OFFSET Input value for a positive or negative offset of the falling ramp of the envelope at the end of a slot.

IEC/IEEE-bus `SOUR:GSM:PRAM:FOFF 1`

SLOT ATTENUATION Input value in dB for the level reduction of all active slots whose SLOT LEVEL was set to ATTEN. Menu SELECT SLOT allows the slots to be determined whose level is to be reduced.

IEC/IEEE-bus command `SOUR:GSM:SLOT:ATT 40 DB`

SAVE/RCL FRAME... Opens a window for saving and loading a frame configuration. Loading a frame affects all parameters that can be set under SELECT SLOT.



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

PEP -30.0 dBm

Fig. 2-162 Menu DIGITAL STD - GSM - SAVE/RCL FRAME, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SAVE/RCL FRAME...)

GET PREDEFINED FRAME... Loads a factory-set frame configuration.

NB0 Normal Burst in slot 0

IEC/IEEE-bus `:SOUR:GSM:FLIS:PRED:LOAD "nb0"`

RECALL FRAME... Loads a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:GSM:FLIS:LOAD "name"`

SAVE FRAME... Saves a user-defined frame configuration.

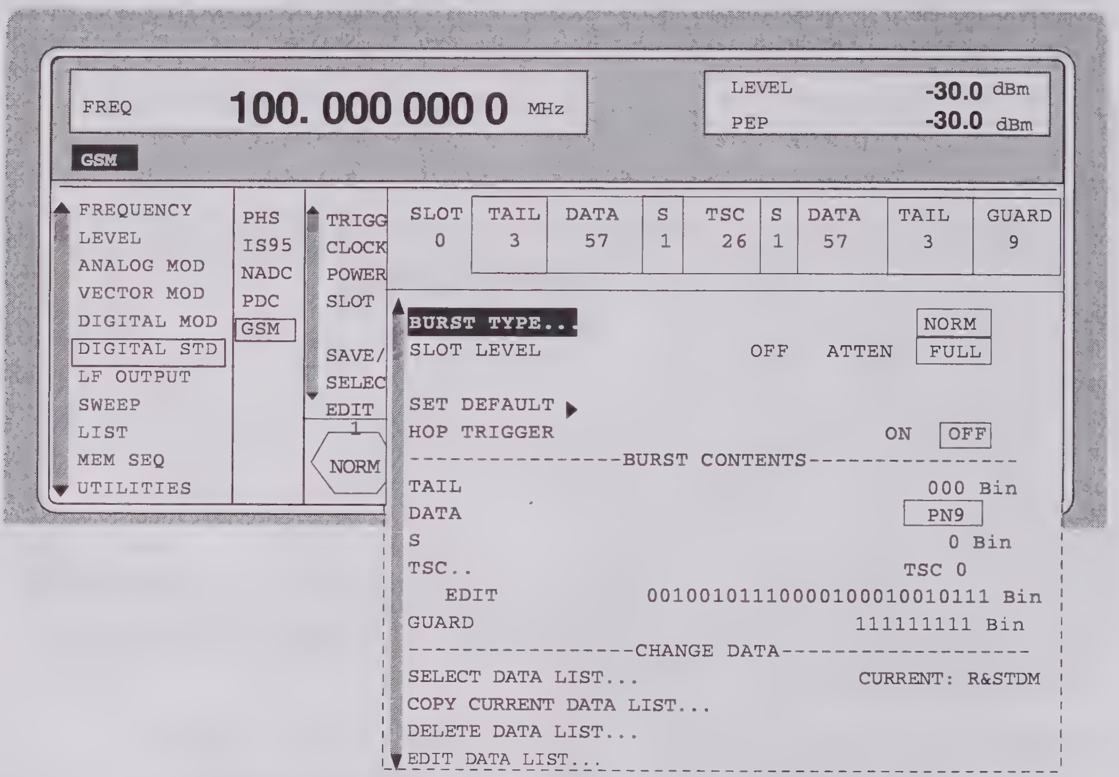
IEC/IEEE-bus `:SOUR:GSM:FLIS:STOR "name"`

DELETE FRAME... Deletes a frame configuration saved by the user.

IEC/IEEE-bus `:SOUR:GSM:FLIS:DEL "name"`

SELECT SLOT... Selection of one of 8 possible slots. When selecting the slot, a window is opened in which the data contents belonging to this slot can be defined.
If the cursor is placed onto a slot in the diagram, it may be switched on and off by pressing one of the unit keys (toggle function).

Menu selection: BURST TYPE = NORM



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm
PEP -30.0 dBm

SLOT	TAIL	DATA	S	TSC	S	DATA	TAIL	GUARD
0	3	57	1	26	1	57	3	9

BURST TYPE... NORM
SLOT LEVEL OFF ATTEN FULL
HOP TRIGGER ON OFF
----------------BURST CONTENTS----------------
TAIL 000 Bin
DATA PN9
S 0 Bin
TSC.. TSC 0
EDIT 00100101110000100010010111 Bin
GUARD 111111111 Bin
-----------------CHANGE DATA------------------
SELECT DATA LIST... CURRENT: R&STDM

Fig. 2-163 Menu DIGITAL STD - GSM - SELECT SLOT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) NORM **BURST TYPE** Opens a window for the selection of the burst type used to configure the selected slot.

NORM Normal Burst
IEC/IEEE `:SOUR:GSM:SLOT2:TYPE NORM`

SLOT LEVEL Selection of level for selected slot.

OFF Maximum attenuation
IEC/IEEE `:SOUR:GSM:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.
IEC/IEEE `:SOUR:GSM:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.
IEC/IEEE `:SOUR:GSM:SLOT2:LEV ATT`

(SELECT SLOT...) NORM

SET DEFAULT ▶ Resets the subsequent parameters to the factory-set values.

IEC/IEEE-bus command `:SOUR:GSM:SLOT8:PRES`

HOP TRIGGER Switches the HOP trigger signal on or off. With ON selected, a HOP signal will be generated at the end of the selected slot. The signal is available at the HOP output of the PARDATA connector. It can be used to perform a frequency hop mode in the LIST MODE (see section 'List Mode').

IIEEE-bus command `SOUR:GSM:SLOT1:HOPP:TRIG`

TAIL Display of data contents in the 3 bit data field "Tail". The tail bits are set to 000 according to the GSM standard.

DATA Selection of data source for DATA fields. These fields are regarded as a continuous field, ie a pseudo-random sequence is fully continued from one DATA field to the next. The following data sources are available:

PN..	PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1. IEC/IEEE `:SOUR:GSM:SLOT3:DATA PN15`
DLIST	Data from a programmable data list. IEC/IEEE `:SOUR:GSM:SLOT3:DATA DLIS`
SERDATA	Data from data input SER DATA. IEC/IEEE `:SOUR:GSM:SLOT3:DATA SDAT`

S Setting for the so-called "Stealing Flag". The selected setting is valid for the two S fields.

IEC/IEEE-bus command `SOUR:GSM:SLOT2:SF 1`

TSC... Opens a window for selecting the so-called "Training Sequence Code". A selection between 8 different training sequences is possible.

IEC/IEEE-bus command `SOUR:GSM:SLOT2:TSC 0`

EDIT Input field for binary modifications of the training sequence. A modified training sequence is stored as a USER sequence after a SAVE FRAME has been called up.

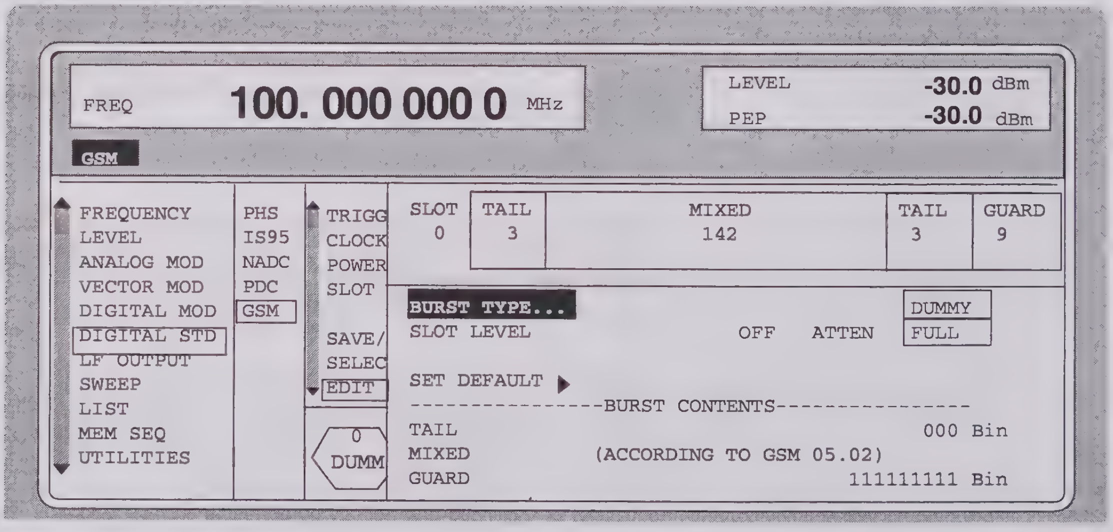
IEC/IEEE-bus command
`SOUR:GSM:SLOT2:USER #B011011...`

GUARD Display of data content in the Guard field in binary form. The length of the field is 8 bit in slots 1,2,3,5,6,7 and 9 bit in slots 0 and 4. It is thus ensured that a frame has exactly 1250 bit as stipulated in the GSM standard.

(SELECT SLOT...) NORM	**SELECT DATA LIST...**	Opens a window for selecting a stored data list or for generating a new list.
	COPY CURRENT DATA LIST TO...	Stores the current data list under a different name.
	DELETE DATA LIST...	Deletes a data list.
	EDIT DATA LIST...	Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

Menu selection: BURST TYPE = DUMMY



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

PEP -30.0 dBm

BURST TYPE...

SLOT LEVEL OFF ATTEN

SET DEFAULT

----------------BURST CONTENTS----------------

TAIL 000 Bin

MIXED (ACCORDING TO GSM 05.02)

GUARD 111111111 Bin

Fig. 2-164 Menu DIGITAL STD - GSM - SELECT SLOT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) DUMMY	**BURST TYPE**	Opens a window for the selection of the burst type used to configure the selected slot.

DUMMY	Synchronization Burst
IEC/IEEE-bus command	`SOUR:GSM:SLOT2:TYPE DUMM`

(SELECT SLOT...) DUMMY

SLOT LEVEL

Selection of level for selected slot.

OFF	Maximum attenuation IEC/IEEE `:SOUR:GSM:SLOT2:LEV OFF`
FULL	The level corresponds to the value indicated on the SMIQ LEVEL display. IEC/IEEE `:SOUR:GSM:SLOT2:LEV FULL`
ATTEN	The level is reduced by the value set under SLOT ATTENUATION. IEC/IEEE .....`:SOUR:GSM:SLOT2:LEV ATT`

TAIL

Display of data content in the 3 bit data field "Tail ". The tail bits are set to 000 according to the GSM standard.

MIXED

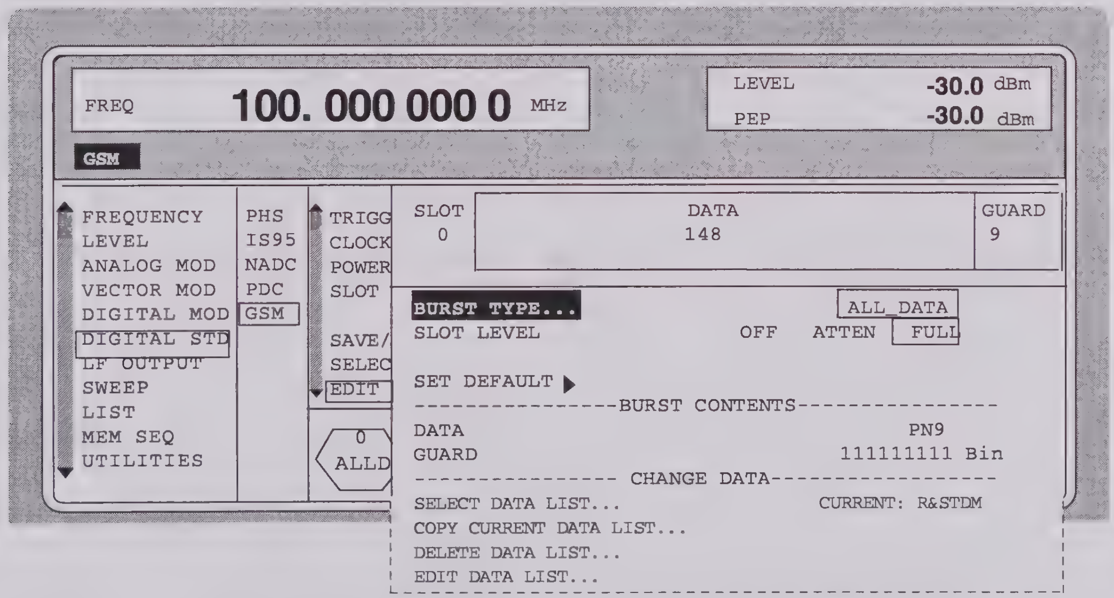
Display of data content of the mixed-bit field. It has a data content stipulated by GSM 05.02, the so-called mixed bits":

11111011011101100000101001001110000010010001000000
01111100011100010111000101110001010111010010100011
001100111001111010011111000100101111101010

GUARD

Display of data content in the Guard field in binary form. The length of the field is 8 bit in slots 1,2,3,5,6,7 and 9 bit in slots 0 and 4. It is thus ensured that a frame has exactly 1250 bit as stipulated in the GSM standard.

Menu selection: BURST TYPE = ALL_DATA



BURST TYPE... ALL_DATA
SLOT LEVEL OFF ATTEN FULL
SET DEFAULT ▶
----------------BURST CONTENTS----------------
DATA PN9
GUARD 111111111 Bin
---------------- CHANGE DATA-----------------
SELECT DATA LIST... CURRENT: R&STDM
COPY CURRENT DATA LIST...
DELETE DATA LIST...
EDIT DATA LIST...

Fig. 2-165 Menu DIGITAL STD - GSM - SELECT SLOT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT...) ALL_DATA

BURST TYPE Opens a window for the selection of burst type used to configure the selected slot.

ALL_DATA Burst type for testing with freely programmable data contents.
IEC/IEEE `:SOUR:GSM:SLOT2:TYPE ADAT`

SLOT LEVEL Selection of level for selected slot.

OFF Maximum attenuation
IEC/IEEE `:SOUR:GSM:SLOT2:LEV OFF`

FULL The level corresponds to the value indicated on the SMIQ LEVEL display.
IEC/IEEE `:SOUR:GSM:SLOT2:LEV FULL`

ATTEN The level is reduced by the value set under SLOT ATTENUATION.
IEC/IEEE `:SOUR:GSM:SLOT2:LEV ATT`

DATA Selection of data source for DATA fields. These fields are regarded as a continuous field, ie a pseudo-random sequence is fully continued from one DATA field to the next. The following data sources are available:

PN.. PRBS data according to CCITT with periods between 2^9-1 and 2^{23}-1.
IEC/IEEE `:SOUR:GSM:SLOT3:DATA PN15`

DLIST Data from a programmable data list.
IEC/IEEE `:SOUR:GSM:SLOT3:DATA DLIS`

SERDATA Data from data input SER DATA.
IEC/IEEE `:SOUR:GSM:SLOT3:DATA SDAT`

GUARD Display of data content in the Guard field in binary form. The length of the field is 8 bit in slots 1,2,3,5,6,7 and 9 bit in slots 0 and 4. It is thus ensured that a frame exactly has 1250 bit as stipulated in the GSM standard.

Parameter **SELECT DATA LIST...** to **EDIT DATA LIST...** see menu selection BURST TYPE = NORM

2.18 Digital Standard DECT

With the options Modulation Coder (SMIQB20) and Data Generator (SMIQB11) provided, modulation signals according to the ETSI DECT standard can be generated . DECT is a TDMA standard for private and public cordless phones.

SMIQ can generate both the transmit signal of a cell station (FP, Fixed Part) and the transmit signal of a personal station (PP, Portable Part). Transmission from FP to PP is called "downlink", "uplink" being used for transmission in the opposite direction.

Uplink and downlink are transmitted in the separate time slots of a frame using the time duplex method. Each frame consists of 24 slots. The data contents of each slot can be defined individually by SMIQ by means of a slot editor. Each slot can be switched on or off. A defined intermediate level can also be set. A maximum of 12 slots within a frame can be switched on simultaneously.

A slot type has to be defined to configure a slot. The following slot types can be selected:

- FULL full slot; simulation of a basic R32 physical channel,
- DOUBLE double slot, simulation of a high capacity R80 physical channel and
- ALL_DATA slot type for test purposes with arbitrarily programmable data contents in full slot format.

The following internal modulation sources are available:

- different PRBS generators with a sequence length between 2^9-1 and 2^{23}-1 and
- data lists, i.e. freely programmable data sequences from the data generator memory.

For generating DECT signals, SMIQ inserts the modulation data continuously (in real time) into the selected slots. Using a digital signal processor the data generator generates a data sequence with modulation data and control signals for envelope control.

The data generator in SMIQ generates a data stream which is converted into IQ signals in the modulation coder. According to the DECT standard, the default modulation type is GFSK with a symbol rate of 1152 ksymbols/s and Gauss filtering. Symbol rate and filtering can be changed in SMIQ. Alternatively, $\pi/4$ DQPSK with $\sqrt{}$cos filtering may be selected.

2.18.1 Sync and Trigger Signals

The data generator generates a data sequence with modulation data, control signals for envelope control, and synchronization signals.

When TRIGGER MODE AUTO is selected, the DECT signal generation starts automatically.

This start can also be activated by an external trigger signal (TRIGGER MODE ARMED_AUTO) which allows a synchronous sequence for BER measurements to be carried out on receivers.

Trigger signals for synchronized sequences can be used for measuring the bit error rate of receivers. A trigger signal can be fed via the TRIGIN input at connector PAR DATA. The active slope of a trigger signal applied there executes a trigger event.
DECT signal generation at a frame limit is started after a trigger event. Data from data lists are inserted into the selected slots starting from the first bit. PRBS generators start with the set initialization status.

Signal generation either starts immediately after the active slope of the trigger signal or after a settable number of symbols (EXT TRIGGER DELAY). Retriggering (RETRIG) can be inhibited for a settable number of symbols (EXT RETRIGGER INHIBIT).

A trigger event can be executed manually or via the IEC/IEEE bus using EXECUTE TRIGGER.

When a trigger event is executed, a trigger signal is output at the TRIGOUT 3 output of SMIQ.

SMIQ also generates the following sync signals:

- a frame clock at TRIGOUT 1 output,
- a frame or multiframe clock at TRIGOUT 2 output with settable position in the frame,
- the symbol clock and the bit clock.

A clock synthesizer on the modulation coder generates the symbol clock and the bit clock in SMIQ. All clock signals are synchronized to the 10-MHz reference of SMIQ. The bit clock is available at connector BIT CLOCK. If desired, the clock synthesizer in SMIQ can be synchronized to an external bit clock.

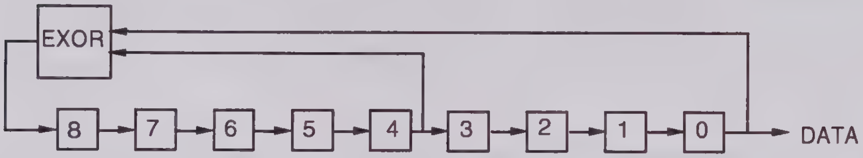
The clock source is selected in the CLOCK-CLOCK SOURCE EXT menu.

To allow for a trouble-free synchronization of the clock synthesizer first apply the external clock and set the correct symbol rate at SMIQ. Then switch CLOCK SOURCE from INT to EXT.

Note: *The set symbol rate should not differ by more than 1% from the symbol rate of the external signal.*

2.18.2 PN Generators as Internal Data Source

Independent PN generators (Pseudo Noise) can be selected for each slot as data sources for the data fields A-FIELD, B-FIELD and DATA. These PN generators provide pseudo-random bit sequences of different length or period. That is why they are also called PRBS generators (Pseudo Random Binary Sequence).
Data sequences are sequences of maximum length which are generated by means of feedback shift registers.
The following figure gives an example of a 9-bit generator with feedbacks after register 4 and 0 (output).



The pseudo-random sequence of a PRBS generator is clearly defined by the number of registers and the feedback. The following table describes all PRBS generators available:

Table 2-35 PRBS generators for DECT

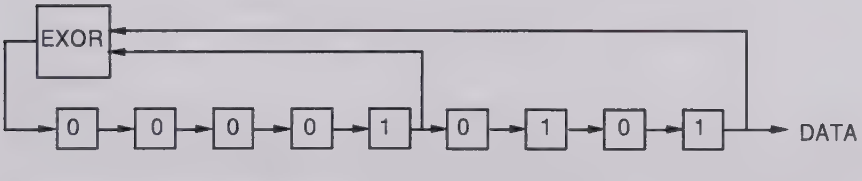
PRBS generator	**Length in bits**	**Feedback after**
9 bit	$2^9 -1 = 511$	Register 4, 0
11 bit	$2^{11} -1 = 2047$	Register 2, 0
15 bit	$2^{15} -1 = 32767$	Register 1, 0
16 bit	$2^{16} -1 = 65535$	Register 5, 3, 2, 0
20 bit	$2^{20} -1 = 1048575$	Register 3, 0
21 bit	$2^{21} -1 = 2097151$	Register 2, 0
23 bit	$2^{23} -1 = 8388607$	Register 5, 0

PN generators PN9,11,15,20 and PN23 are configured according to CCITT Rec. 0.151/152/153. The output sequence is inverted for generators PN15 and PN23.

The start value of the PN generators is different in the slots and equals

$$\text{start value} = 1 + 14\,\text{hex} \times \text{slot number}$$

Example: PN9 generator in slot 1 with start value 15hex = 10101 binary.



The resulting output sequence is `1010100000010100101011110010` etc.

2.18.3 Lists as Internal Data Source

A freely programmable memory on the data generator serves as an additional internal data source for the data fields of the slots. The data are managed in so-called lists. A list editor allows to select, copy, modify and delete data lists (DATA LIST).
The list editor is available via menu DIGITAL-MOD - SOURCE....

2.18.4 External Modulation Data

External data can (only) be applied via the SERDATA interface. A selection of SERDATA as data source is only possible for a single data field of a slot. For further information on the characteristics of the SERDATA interface see Annex A.

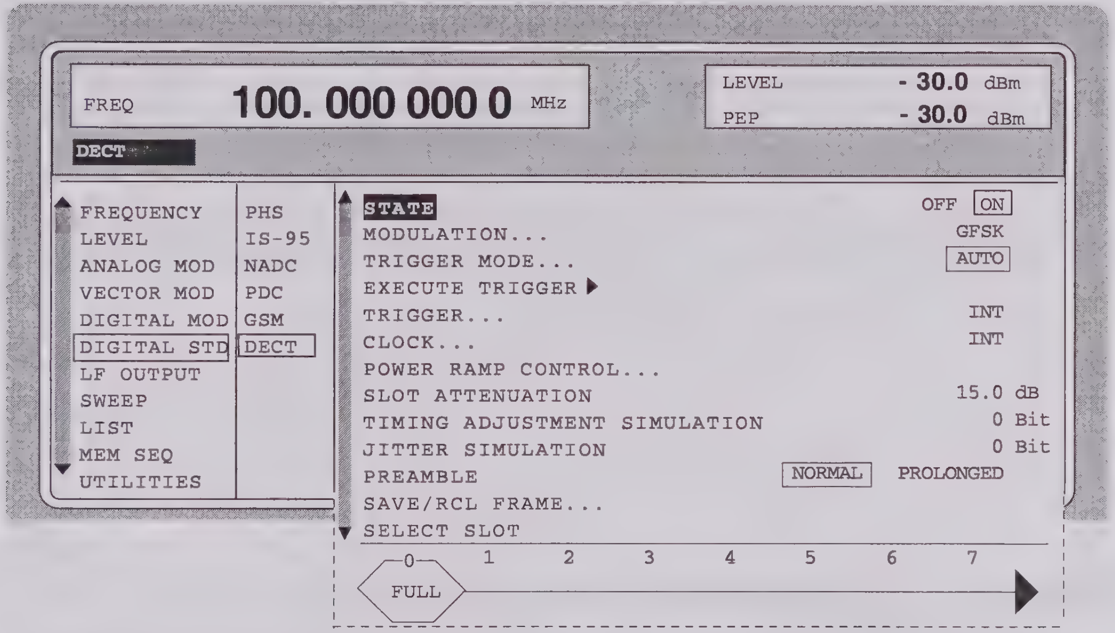
To ensure that the external data bits are assigned to specific positions in the data field of the selected slot and that they are reproducible, the buffer of the RS-232 transmitter and receiver has to be deleted. A triggered start has to follow.
The following setting sequence is required in the DIGITAL STD - DECT menu:

1. Carry out desired settings in menu.
2. Select data source SERDATA for the data field of the slot using SELECT SLOT - ....
3. Make connection to external data source, but do not yet start external data source.
4. Switch off digital standard using STATE - OFF.
5. Set TRIGGER MODE ARMED_AUTO.
   In this state, SMIQ is ready for reception, but discards data that are read in via SERDATA.
6. Switch on digital standard with STATE ON.
7. Start external data source.
   The read-in data are written into the receiving buffer. Only if this buffer is filled can SMIQ react to a trigger event.
8. Activate trigger event. Signal generation is thus started at a frame limit. The first bit received via SERDATA is put to the first bit position in the selected data field.

2.18.5 Menu DIGITAL STANDARD - DECT

Menu DIGITAL STD - DECT provides access to settings for generating DECT signals.

Menu selection: DIGITAL STD - DECT



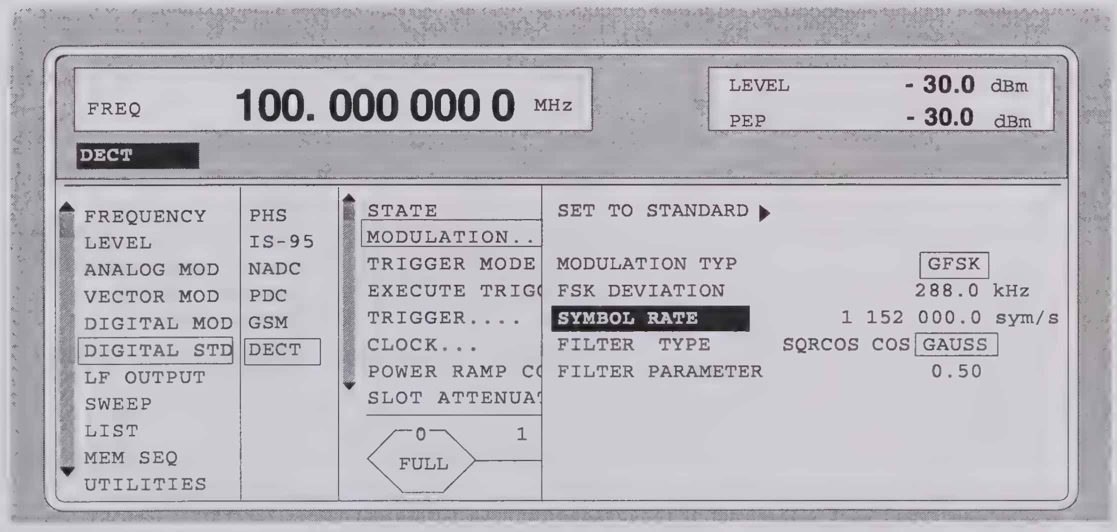
```
FREQ    100. 000 000 0 MHz                 LEVEL   - 30.0 dBm
                                           PEP     - 30.0 dBm
DECT

FREQUENCY     PHS     STATE                                      OFF  ON
LEVEL         IS-95   MODULATION...                                  GFSK
ANALOG MOD    NADC    TRIGGER MODE...                                AUTO
VECTOR MOD    PDC     EXECUTE TRIGGER ▶
DIGITAL MOD   GSM     TRIGGER...                                      INT
DIGITAL STD   DECT    CLOCK...                                        INT
LF OUTPUT             POWER RAMP CONTROL...
SWEEP                 SLOT ATTENUATION                             15.0 dB
LIST                  TIMING ADJUSTMENT SIMULATION                   0 Bit
MEM SEQ               JITTER SIMULATION                              0 Bit
UTILITIES             PREAMBLE                         NORMAL   PROLONGED
                      SAVE/RCL FRAME...
                      SELECT SLOT
                        0     1     2     3     4     5     6     7
                       FULL
```

Fig. 2-166 Menu DIGITAL STD - DECT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

STATE Switch on/off of Digital Standard DECT modulation. Vector Modulation or Digital Modulation will be switched off automatically.

IEC/IEEE-bus command `:SOUR:DECT:STAT ON`

MODULATION... Opens a window for setting some of the modulation parameters.



```
FREQ    100. 000 000 0 MHz                 LEVEL   - 30.0 dBm
                                           PEP     - 30.0 dBm
DECT

FREQUENCY     PHS     STATE            SET TO STANDARD ▶
LEVEL         IS-95   MODULATION..
ANALOG MOD    NADC    TRIGGER MODE     MODULATION TYP                 GFSK
VECTOR MOD    PDC     EXECUTE TRIG(    FSK DEVIATION               288.0 kHz
DIGITAL MOD   GSM     TRIGGER....      SYMBOL RATE          1 152 000.0 sym/s
DIGITAL STD   DECT    CLOCK...         FILTER  TYPE      SQRCOS COS GAUSS
LF OUTPUT             POWER RAMP C(    FILTER PARAMETER              0.50
SWEEP                 SLOT ATTENUA
LIST                     0      1
MEM SEQ                 FULL
UTILITIES
```

Fig. 2-167 Menu DIGITAL STD - DECT - MODULATION...

(MODULATION...)	**SET TO STANDARD ▶**	Sets the subsequent modulation parameters to the values predefined by the standard. IEC/IEEE-bus `:SOUR:DECT:STAN`
	MODULATION TYPE	Selection of the modulation type. GFSK is preset. IEC/IEEE-bus `:SOUR:DECT:FORM GFSK`
	FSK DEVIATION	Input value for the frequency deviation for GFSK modulation IEC/IEEE-bus `:SOUR:DECT:FSK 280 KHZ`
	SYMBOL RATE	Input value for the symbol rate. 1152 ksymbols/s are preset. IEC/IEEE-bus `:SOUR:DECT:SRAT 1151 KHZ`
	FILTER TYPE	Selection of baseband filter. For π/4 DQPSK modulation, a selection between Nyquist filters COS and SQRCOS is possible. IEC/IEEE-bus `:SOUR:DECT:FILT:TYPE COS`
	FILTER PARAMETER	Input value for the BT value for Gauss filtering or for the roll-off factor for Nyquist filtering. IEC/IEEE-bus `SOUR:DECT:FILT:PAR 0.51`
TRIGGER MODE...	Opens a window for selecting the trigger mode.	
	AUTO	The DECT signals are continuously transmitted in the activated slots. IEC/IEEE-bus command `SOUR:DECT:SEQ AUTO`
	RETRIG	The DECT signals are continuously transmitted in the activated slots. A trigger event causes a restart. This mode is not available if values different from zero are set for TIMING ADJUSTMENT or JITTER SIMULATION. IEC/IEEE-bus command `:SOUR:DECT:SEQ RETR`
	ARMED_AUTO	DECT signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the AUTO mode and can no longer be triggered. IEC/IEEE-bus command `:SOUR:DECT:SEQ AAUT`
	ARMED_RETRIG	DECT signal generation does not start until a trigger event has occurred. The unit then automatically switches over to the RETRIG mode. Each new trigger event causes a restart. This mode is not available if values different from zero are set for TIMING ADJUSTMENT or JITTER SIMULATION. IEC/IEEE-bus command `:SOUR:DECT:SEQ ARET`

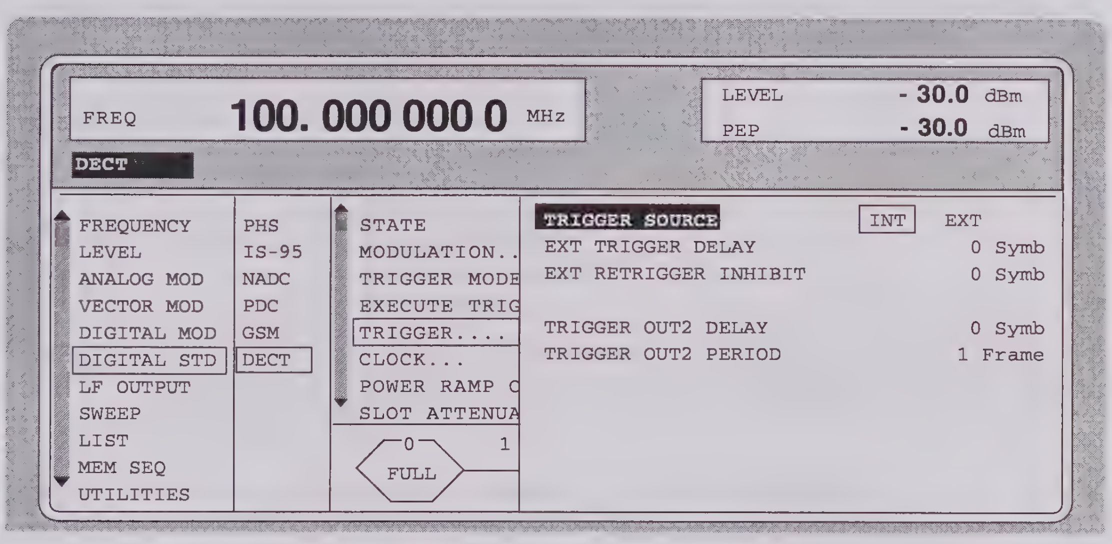
EXECUTE TRIGGER ▶

Executes a trigger even to start the DECT signal generation. This menu item is not available if TRIGGER MODE - AUTO is set.

IEC/IEEE-bus command `:TRIG:DM:IMM`

TRIGGER...

Opens a window for selecting the trigger source, for configuring the trigger output signals and for setting the time delay of an external trigger signal.



```
FREQ      100. 000 000 0 MHz
LEVEL     - 30.0 dBm
PEP       - 30.0 dBm

TRIGGER SOURCE                 INT   EXT
EXT TRIGGER DELAY                  0 Symb
EXT RETRIGGER INHIBIT              0 Symb

TRIGGER OUT2 DELAY                 0 Symb
TRIGGER OUT2 PERIOD               1 Frame
```

Fig. 2-168 Menu DIGITAL STD - DECT_TRIGGER..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(TRIGGER...) **TRIGGER SOURCE**

Selection of trigger source.

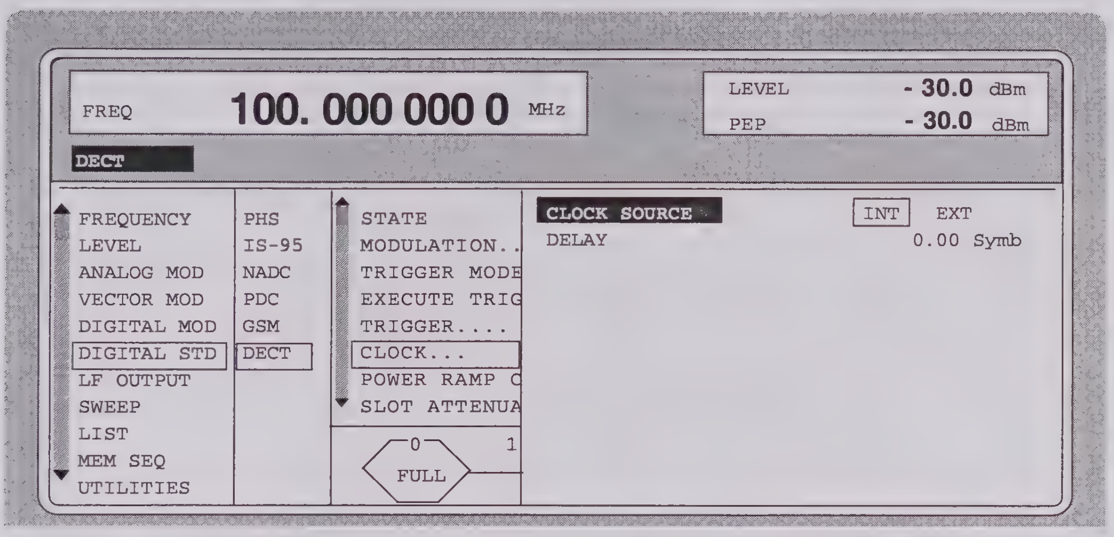
EXT — The DECT signal generation is started by the active slope of an external trigger signal.
The polarity, the trigger threshold and the input resistance of the TRIGIN input can be modified in menu DIGITAL MOD - EXT INPUTS.

INT — A trigger event can be executed by EXECUTE TRIGGER ▶.

IEC/IEEE-bus `:SOUR:DECT:TRIG:SOUR EXT`

(TRIGGER...)	**EXT TRIGGER DELAY**	Setting the number of symbols by which an external trigger signal is delayed before it starts the DECT signal generation. This is used for setting the time synchronization between the SMIQ and the DUT. IEC/IEEE-bus `:SOUR:DECT:TRIG:DEL 3`
	EXT RETRIGGER INHIBIT	Setting the number of symbols for which a restart is inhibited after a trigger event. With TRIGGER MODE RETRIG selected, each new trigger signal restarts the DECT signal generation. This restart can be inhibited for the entered number of symbols. Example: The entry of 1000 symbols causes new trigger signals to be ignored for the duration of 1000 symbols after a trigger event IEC/IEEE-bus `:SOUR:DECT:TRIG:INH 1000`
	TRIGGER OUT2 DELAY	Input value of delay of trigger signal at TRIGOUT 2 output compared with beginning of frame. IEC/IEEE-bus `:SOUR:DECT:TRIG:OUTP:DEL 2`
	TRIGGER OUT2 PERIOD	Input value of output signal period at TRIGOUT 2 output given in frames. IEC/IEEE-bus `:SOUR:DECT:TRIG:OUTP:PER 1`

CLOCK... Opens a window for selecting the clock source and for setting a delay.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 30.0 dBm

CLOCK SOURCE INT EXT

DELAY 0.00 Symb

Fig. 2-169 Menu DIGITAL STD - DECT - CLOCK..., SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(CLOCK...)

CLOCK SOURCE Selection of clock source.

INT SMIQ uses internally generated clock signals.

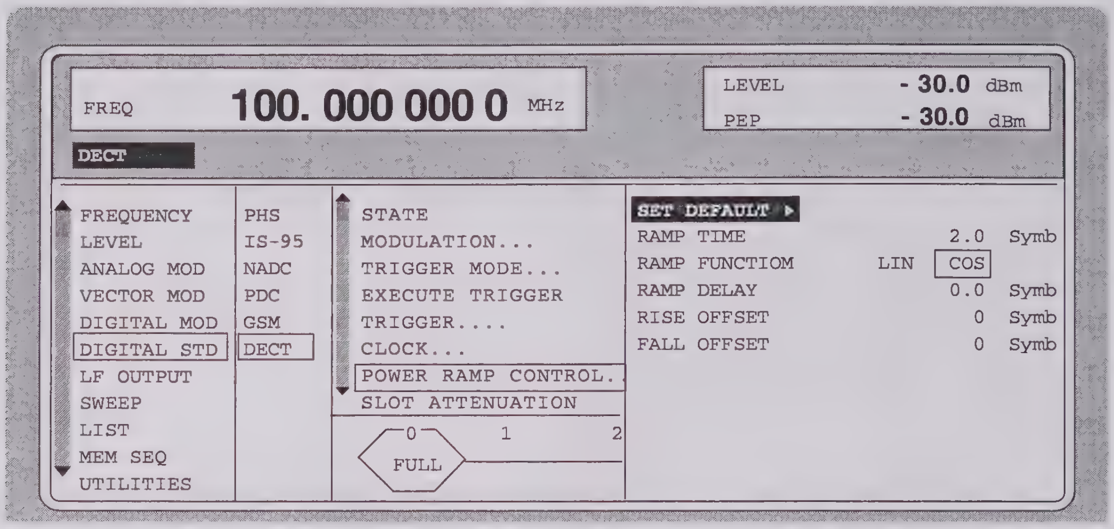
EXT An external symbol clock or bit clock is fed in at connectors SYMBOL CLOCK or BIT CLOCK. The clock synthesizer on the modulation coder is synchronized to this clock.
The symbol rate has to be set with an accuracy of ± 1 %.
The polarity, the trigger threshold and the input resistance of the clock inputs can be modified in menu DIGITAL MOD - EXT INPUTS.

IEC/IEEE-bus command `:SOUR:DECT:CLOC:SOUR INT`

DELAY Setting the delay of generated modulation signal to an external clock.
This can be used, for example, for synchronization with a second unit to achieve time synchronization between the modulation signals of the two units.

IEC/IEEE-bus command `:SOUR:DECT:CLOC:DEL 0.5`

POWER RAMP CONTROL... Opens a window for setting the envelope control, especially for the rising and falling ramp at the beginning and end of a slot.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 30.0 dBm

RAMP TIME 2.0 Symb

RAMP FUNCTIOM LIN COS

RAMP DELAY 0.0 Symb

RISE OFFSET 0 Symb

FALL OFFSET 0 Symb

Fig. 2-170 Menu DIGITAL STD - DECT - POWER RAMP CONTROL... , SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(POWER RAMP CONTROL...)

SET DEFAULT Sets the subsequent parameters to factory-set default values.

IEC/IEEE-bus `SOUR:DECT:PRAM:PRES`

RAMP TIME Input value for the rise and fall time of the envelope at the beginning or end of a slot. The time is set in units of the symbol period.

IEC/IEEE-bus `SOUR:DECT:PRAM:TIME 1.5`

RAMP FUNCTION Selection of shape of rising and falling ramp for envelope control.

LIN	Linear ramp function.
COS	Cosine function. A more favorable spectrum than that of the LIN function is obtained.

IEC/IEEE-bus `SOUR:DECT:PRAM:SHAP LIN`

RAMP DELAY Input value for a shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope. The values are set in units of the symbol length.

IEC/IEEE-bus `SOUR:DECT:PRAM:DEL 0.1`

RISE OFFSET Input value for a positive or negative offset of the rising ramp of the envelope at the beginning of a slot.

IEC/IEEE-bus `SOUR:DECT:PRAM:ROFF -1`

FALL OFFSET Input value for a positive or negative offset of the falling ramp of the envelope at the end of a slot.

IEC/IEEE-bus `:SOUR:DECT:PRAM:FOFF 1`

SLOT ATTENUATION

Input value for the level attenuation in dB of all active slots whose SLOT LEVEL was set to ATTEN. The slots whose level is to be attenuated are defined in the menu SELECT SLOT.

IEC/IEEE-bus command `:SOUR:DECT:SLOT:ATT 40 DB`

TIMING ADJUSTMENT SIMULATION

Input value for the number of bits used for simulating "Timing Adjust" in DECT instruments. Each 35th frame is extended (positive input values) or shortened (negative values) by the number of bits set.

IEC/IEEE-bus command `:SOUR:DECT:SIM:TADJ -1`

JITTER SIMULATION

Input value for the number of bits used for jitter simulation. A jitter is simulated by advancing the selected number of bits for even-numbered frames in time whereas ordinary timing is generated for odd-numbered frames.

IEC/IEEE-bus command `:SOUR:DECT:SIM:JITT 1`

PREAMBLE

Selection of the preamble type for full and double slot.

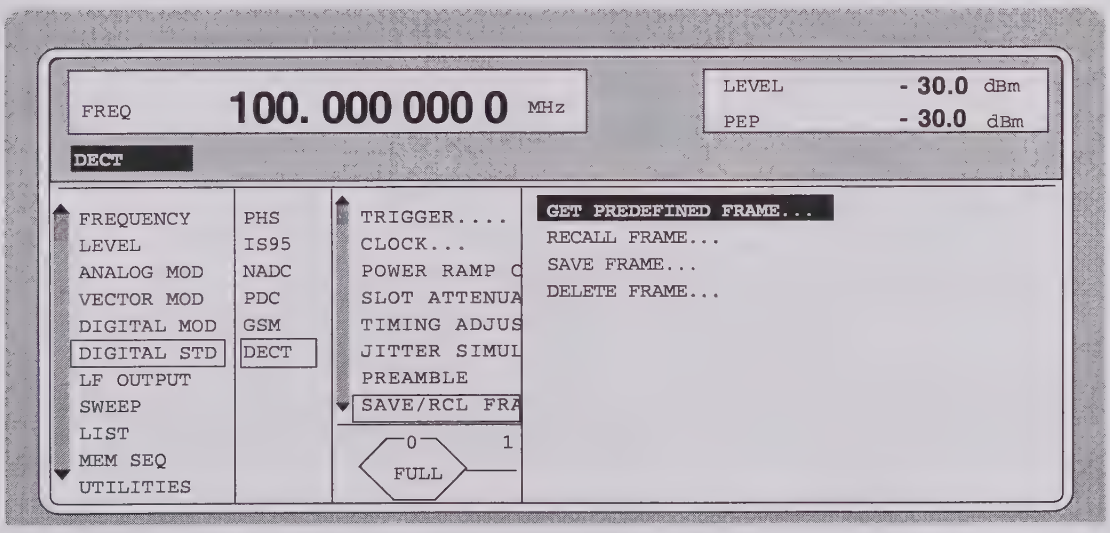
NORMAL The preamble field has a length of 16 bits.

PROLONGED The preamble field has a length of 32 bits.

IEC/IEEE-bus command `:SOUR:DECT:PRE NORM`

SAVE/RCL FRAME...

Opens a window for saving and loading a frame configuration. Loading a frame affects all parameters that can be set under SELECT SLOT.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

PEP - 30.0 dBm

Fig. 2-171 Menu DIGITAL STD - DECT - SAVE/RCL FRAME, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SAVE/RCL FRAME...) **GET PREDEFINED FRAME...**

Loads a factory-set frame configuration.

DNFULL	All downlink slots numbered 0 to 11 are active as full slots.
UPFULL	All uplink slots numbered 12 to 23 are active as full slots.
FULL_0	Only slot no. 0 is active as a full slot.
DOUB_0	Slots no. 0 and 1 are active as double slots.

IEEE `SOUR:DECT:FLIS:PRED:LOAD "name"`

RECALL FRAME...

Loads a frame configuration saved by the user.

IEC/IEEE-bus `SOUR:DECT:FLIS:LOAD "name"`

SAVE FRAME...

Saves a user-defined frame configuration.

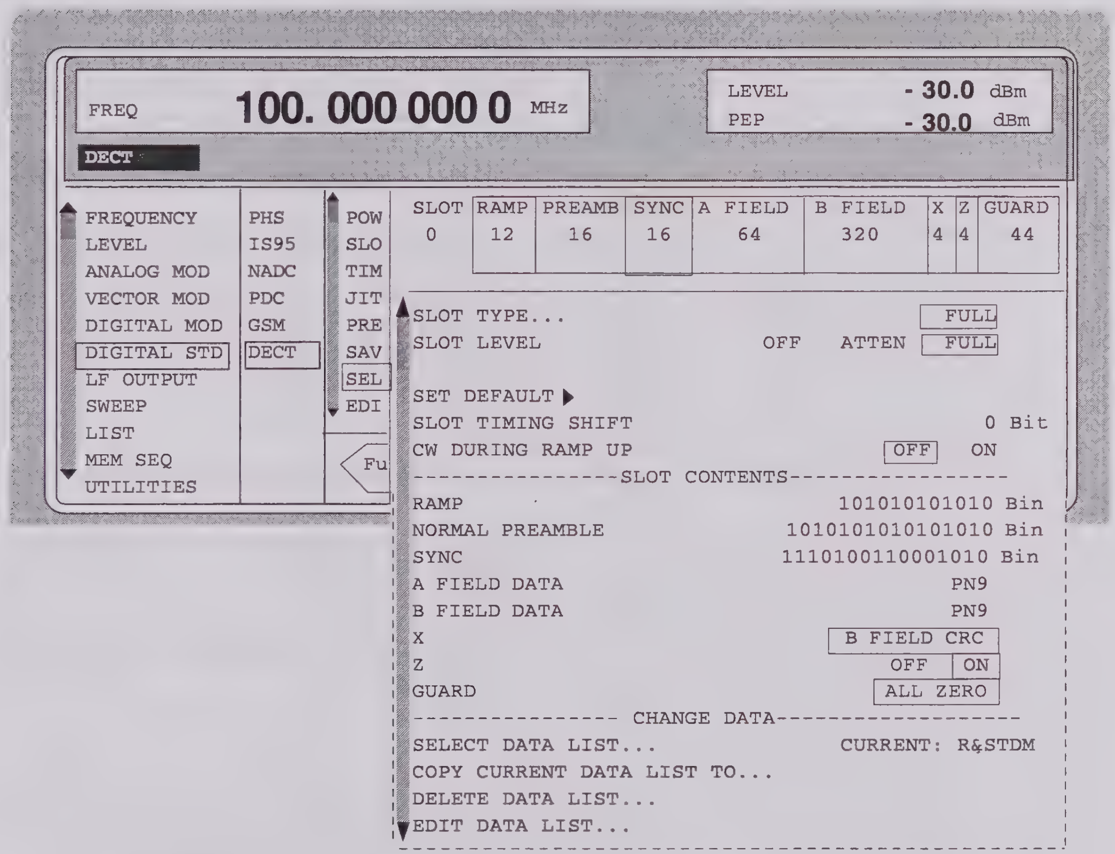
IEC/IEEE-bus `SOUR:DECT:FLIS:STOR "name"`

DELETE FRAME...

Deletes a frame configuration saved by the user.

IEC/IEEE-bus `SOUR:DECT:FLIS:DEL "name"`

SELECT SLOT... Selection of one of 24 possible slots. When selecting the slot, a window is opened in which the data contents belonging to this slot can be defined.
12 slots are available for uplink and downlink, respectively. They are labeled UP<i> and DN<i> in the display where i varies from 0 to 23. Up to 12 of the 24 slots can be active at the same time.
If the cursor is placed onto a slot in the diagram, the SLOT LEVEL may be modified by pressing one of the unit keys (toggle function).



SLOT	RAMP	PREAMB	SYNC	A FIELD	B FIELD	X	Z	GUARD
0	12	16	16	64	320	4	4	44

```
SLOT TYPE...                                   FULL
SLOT LEVEL                   OFF    ATTEN      FULL

SET DEFAULT ▶
SLOT TIMING SHIFT                              0 Bit
CW DURING RAMP UP                        OFF    ON
----------------SLOT CONTENTS-----------------
RAMP                              101010101010 Bin
NORMAL PREAMBLE               1010101010101010 Bin
SYNC                          1110100110001010 Bin
A FIELD DATA                                  PN9
B FIELD DATA                                  PN9
X                                     B FIELD CRC
Z                                        OFF  ON
GUARD                                    ALL ZERO
---------------- CHANGE DATA------------------
SELECT DATA LIST...              CURRENT: R&STDM
COPY CURRENT DATA LIST TO...
DELETE DATA LIST...
EDIT DATA LIST...
```

Fig. 2-172 Menu DIGITAL STD - DECT - SELECT SLOT, SMIQ equipped with Modulation Coder SMIQB20 and Data Generator SMIQB11

(SELECT SLOT) **SLOT TYPE...** Opens a window for selecting the slot type.

FULL Full slot configuration for simulating a basic R32 physical channel.
IEEE-bus `:SOUR:DECT:SLOT2:TYPE FULL`

DOUBLE Double slot configuration for simulating a high capacity R80 physical channel.
IEEE-bus `:SOUR:DECT:SLOT2:TYPE DOUB`

ALL_DATA SLOT type for test purposes with arbitrarily programmable data contents.
IEEE-bus `:SOUR:DECT:SLOT2:TYPE ADAT`

(SELECT SLOT) **SLOT LEVEL**

Selection of the level for the selected slot.

OFF	Maximum attenuation IEEE bus `:SOUR:DECT:SLOT2:LEV OFF`
FULL	The level corresponds to the value indicated on the SMIQ LEVEL display. IEEE bus `:SOUR:DECT:SLOT2:LEV FULL`
ATTEN	The level is attenuated by the value set under SLOT ATTENUATION. IEEE bus `:SOUR:DECT:SLOT2:LEV ATT`

Note: *If the cursor is placed onto a slot in the diagram, the SLOT LEVEL may be modified by pressing one of the unit keys (toggle function).*

SET DEFAULT ▶

Resets the subsequent parameters to factory-set default values.

IEC/IEEE-bus command `SOUR:DECT:SLOT8:PRES`

SLOT TIMING SHIFT

Input value for the number of bits used for simulating a faulty slot timing. The active slot is shifted in time by the selected number of bits. A positive input value delays the slot, a negative value advances the slot in time.

IEEE bus command `:SOUR:DECT:SLOT2:STSH 1`

CW DURING RAMP UP

Switches the modulation during the rise of the power ramp on or off.

ON	Before the preamble starts, the modulation is switched off so that only the unmodulated carrier is generated.
OFF	Before the preamble starts, the modulation is switched on and the data bits in the ramp field are modulated.

IEEE bus command `:SOUR:DECT:SLOT2:RAMP:CW ON`

RAMP

Input value for the 12-bit data field RAMP in binary format. This data field is not defined in the DECT standard. It is used to define the data contents during the rise of the power ramp. A series of data representing the natural extension of the preamble bits in forward direction is set by default.

IEEE `:SOUR:DECT:SLOT2:RAMP:DATA #B111111111111`

NORMAL PREAMBLE

Input value for the NORMAL PREAMBLE in binary format. According to the DECT standard, the default setting for this 16-bit data field is different for uplink and downlink slots. This data field is not available for slot type ALL_DATA.

IEEE `:SOUR:DECT:SLOT2:PRE:DATA #B1010...`

(SELECT SLOT)

PROLONGED PREAMBLE

Input value for the PROLONGED PREAMBLE in binary format. According to the DECT standard, the default setting for this 32-bit data field is different for uplink and downlink slots. This data field is not available for slot type ALL_DATA.

IEEE `:SOUR:DECT:SLOT2:PRE:PROL:DATA #B1010...`

SYNC

Input value for the 16-bit data field SYNC in binary format. According to the DECT standard, the default setting for this 32-bit data field is different for uplink and downlink slots. This data field is not available for slot type ALL_DATA.

IEEE `:SOUR:DECT:SLOT2:SYNC #B1001...`

A FIELD DATA

Selection of the data source for the A FIELD. The 64-bit A data field is only displayed for the slot types FULL and DOUBLE.

PN.. PRBS data according to CCITT V52 or Rec. 0.151 with period lengths between 2^9-1 and 2^{23}-1.

IEEE bus `:SOUR:DECT:SLOT3:AFI PN15`

DLIST Data from a programmable list.

IEEE bus `:SOUR:DECT:SLOT3:AFI DLIS "name"`
`:SOUR:DECT:SLOT3:AFI DLIS`

SERDATA Data fed in via the entry SER DATA.

IEEE-bus `:SOUR:DECT:SLOT3:AFI SDAT`

B FIELD DATA

Selection of the data source for the B FIELD. The B data field is only displayed for the slot types FULL and DOUBLE. Its length is 320 bits for full slot and 800 bits for double slot.

PN.. PRBS data according to CCITT V52 or Rec. 0.151 with period lengths between 2^9-1 and 2^{23}-1.

IEE-bus `:SOUR:DECT:SLOT3:BFI PN15`

DLIST Data from a programmable list.

IEEE-bus `:SOUR:DECT:SLOT3:BFI DLIS "name"`
`:SOUR:DECT:SLOT3:BFI DLIS`

SERDATA Data fed in via the entry SER DATA.

IEEE-bus `:SOUR:DECT:SLOT3:BFI SDAT`

(SELECT SLOT) **DATA**

Selection of the data source for the 424-bit data field DATA. The B data field is only displayed for the slot type ALL_DATA.

PN..	PRBS data according to CCITT V52 or Rec. 0.151 with period lengths between 2^9-1 and 2^{23}-1. IEEE-bus `:SOUR:DECT:SLOT3:DATA PN15`
DLIST	Data from a programmable list. IEEE-bus `:SOUR:DECT:SLOT3:DATA DLIS "name"` `:SOUR:DECT:SLOT3:DATA DLIS`
SERDATA	Data fed in via the entry SER DATA. IEEE-bus `:SOUR:DECT:SLOT3:DATA SDAT`

X

This 4-bit data field can not be edited. It contains a CRC (Cyclic Redundancy Code) generated from the data in the B data field according to the DECT standard. This data field is not available for slot type ALL_DATA.

Z

Switches the Z field on and off. This function is available for the slot types FULL and DOUBLE.

ON	The CRC (Cyclic Redundancy Code) generated for the X field is repeated in the 4-bit data field Z.
OFF	The Z field is not activated. The guard field is extended by 4 bits.

IEEE-bus command `:SOUR:DECT:SLOT2:ZFI ON`

GUARD

This data field can not be edited and contains zero data. At the beginning of the GUARD field, the power ramp of the active slot starts falling.

SELECT DATA LIST...

Opens a window for selecting a stored data list or for generating a new list.

COPY CURRENT DATA LIST TO...

Stores the current data list under a different name.

DELETE DATA LIST...

Deletes a data list.

EDIT DATA LIST...

Opens a window for editing a data list bit-by-bit. The available storage capacity and the length of the current list is displayed in parameters FREE and LEN (see also Section List Editor).

COPY	Copies a list range
FILL	Fills the range with filler pattern
INSERT	Inserts a list range at a different position of the list
DELETE	Deletes a list range
EDIT/VIEW	Edits or views the list

2.19 External Modulation Source AMIQ

AMIQ from Rohde&Schwarz is now available as an external source for I/Q modulation signals. The generated signals are provided by the unit at modulation outputs I and Q on the front panel. The signals can be fed to modulation inputs I and Q of SMIQ.
With vector modulation mode activated, SMIQ modulates (I/Q modulation) the modulation signals generated by AMIQ onto the RF carrier.

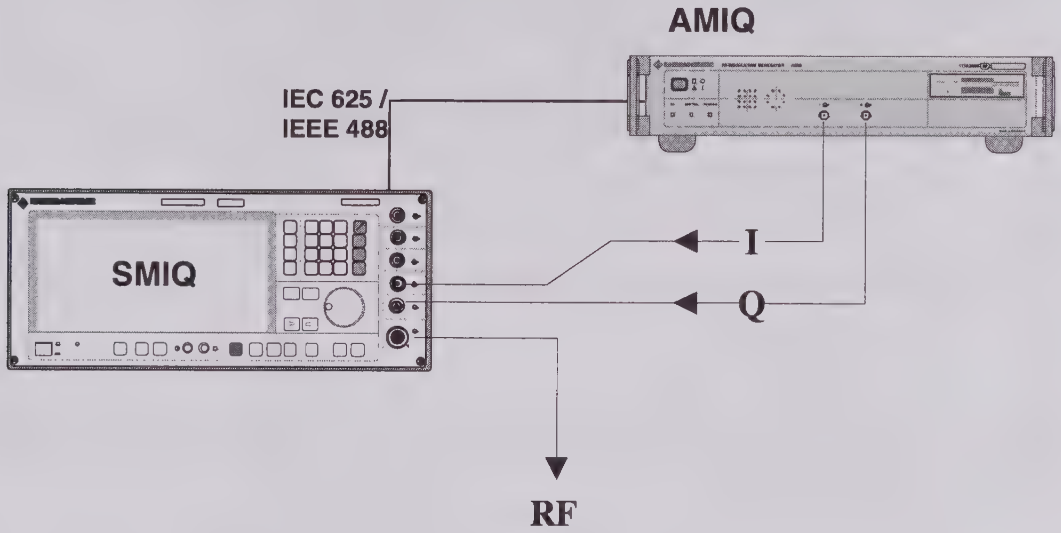


Fig. 2-173 Vector modulation with an external AMIQ

Menu VECTOR MOD provides access to settings required for vector modulation. Settings for generating the modulation signals are made in menu AMIQ CTRL. This menu allows to set the most important parameters of AMIQ via the remote-control interface IEC625/IEEE488. The IEC/IEEE-bus address of AMIQ is given in menu UTILITIES / SYSTEM / GPIB.

Note: *Menu AMIQ CTRL is masked out when SMIQ is delivered. It has to be switched on in menu UTILITIES / INSTALL.*

Complex signal data are created on the PC using Windows software WinIQSIM.

1. If WinIQSIM and AMIQ are linked via IEC/IEEE-bus or RS232 interface, signal data can be fully stored as waveform file on the hard disk of AMIQ. Signal data are then loaded from SMIQ to AMIQ by means of the following commands: SELECT WAVEFORM/EXECUTE BATCH ... DRIVE, HARDDISK and by selection of the file name.
2. If there is no remote-control connection between WinIQSIM and AMIQ, signal data up to 300.000 samples can be stored as waveform file on floppy. Signal data are then loaded from SMIQ to AMIQ by means of the following commands:
   SELECT WAVEFORM/EXECUTE BATCH ... DRIVE, FLOPPY.

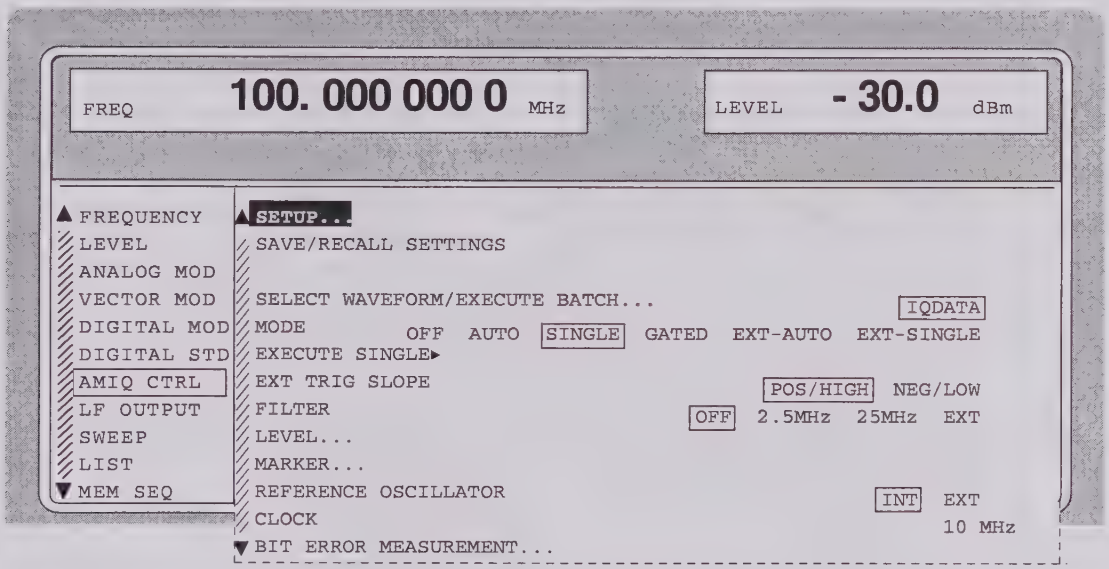
   A faster access is possible if signal data are stored as batch files on a floppy. The floppy is then inserted into AMIQ and the batch file is called up from SMIQ by means of the following commands:
   SELECT WAVEFORM/EXECUTE BATCH ...EXECUTE BATCH FROM FLOPPY.
   The signal data are stored as waveform file on the AMIQ hard disk under the name defined in WinIQSIM. After that, the waveform file can be loaded as described under 2.

For generation of waveform files for AMIQ see chapter on "Menu item AMIQ" in the WinIQSIM manual".

The system consisting of SMIQ as modulation coder, AMIQ as source for baseband signals and WinIQSIM for signal data configuration makes the generation of any complex, digitally modulated communication signals convenient and easy.

To remote control AMIQ via IEC625/IEEE488, SMIQ is configured as a system controller. In the normal mode, SMIQ is configured as a talker/listener.
In general, only one unit can be the system controller on the bus.
With menu AMIQ CTRL called up, SMIQ is automatically configured as the controller. If this is not possible since for example another unit (eg a PC) has already taken over the controller function, menu AMIQ CTRL will not be opened and an error message will be issued.
When menu AMIQ CTRL is closed, SMIQ will again switch to the talker/listener mode.

Menu selection: AMIQ CTRL



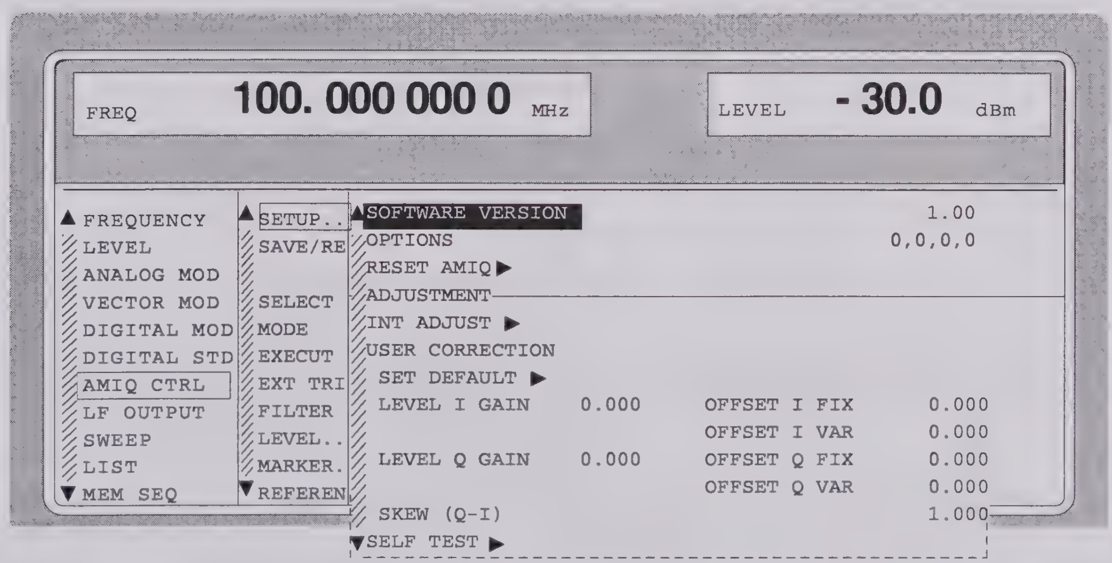
FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

▲ FREQUENCY
LEVEL
ANALOG MOD
VECTOR MOD
DIGITAL MOD
DIGITAL STD
AMIQ CTRL
LF OUTPUT
SWEEP
LIST
▼ MEM SEQ

▲ SETUP...
SAVE/RECALL SETTINGS
SELECT WAVEFORM/EXECUTE BATCH... [✓ IQDATA]
MODE OFF AUTO [✓ SINGLE] GATED EXT-AUTO EXT-SINGLE
EXECUTE SINGLE▶
EXT TRIG SLOPE [✓ POS/HIGH] NEG/LOW
FILTER [✓ OFF] 2.5MHz 25MHz EXT
LEVEL...
MARKER...
REFERENCE OSCILLATOR [✓ INT] EXT
CLOCK 10 MHz
▼ BIT ERROR MEASUREMENT...

Fig. 2-174 Menu AMIQ CTRL (presetting depends on AMIQ)

SETUP... Opens a window to set the basic configuration of AMIQ.
The window offers functions to perform automatic adjustment, fine adjustment, selftest and to reset to a defined basic state.



FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm

▲ FREQUENCY
LEVEL
ANALOG MOD
VECTOR MOD
DIGITAL MOD
DIGITAL STD
AMIQ CTRL
LF OUTPUT
SWEEP
LIST
▼ MEM SEQ

▲ SETUP..
SAVE/RE
SELECT
MODE
EXECUT
EXT TRI
FILTER
LEVEL..
MARKER.
▼ REFEREN

▲ SOFTWARE VERSION 1.00
OPTIONS 0,0,0,0
RESET AMIQ ▶
ADJUSTMENT
INT ADJUST ▶
USER CORRECTION
SET DEFAULT ▶
LEVEL I GAIN 0.000 OFFSET I FIX 0.000
OFFSET I VAR 0.000
LEVEL Q GAIN 0.000 OFFSET Q FIX 0.000
OFFSET Q VAR 0.000
SKEW (Q-I) 1.000
▼ SELF TEST ▶

Fig. 2-175 Menu AMIQ CTRL -SETUP...

(SETUP...)	**SOFTWARE VERSION**	Display of the current AMIQ firmware version AMIQ.
	OPTIONS	Display of AMIQ options.
	RESET AMIQ ▶	Resets AMIQ to a defined basic state.
	INT ADJUST ▶	Starts automatic self-adjustment of AMIQ: – Level adjustment (I/Q) to 1.0 Volt when fully equipped – Offset adjustment (I/Q) to a minimum – Fine adjustment of reference oscillator to 10 MHz – Minimization of delay between I and Q channel
	USER CORRECTION	The user correction allows the fine adjustment of level and offset of the I and Q channel as well as the minimization of the delay between the channels of the complete system. The internal adjustment (INT ADJUST) is not taken into account.
	SET DEFAULT ▶	Resets the user correction to the default values. This applies to the following parameters: – LEVEL I GAIN (*) – OFFSET I FIX (*) – OFFSET I VAR (**) – LEVEL Q GAIN (*) – OFFSET Q FIX (*) – OFFSET Q VAR (**) – SKEW (I-Q) * These parameters will only be effective provided that a fixed level of 0.5 V/50 Ohm has been assigned to the corresponding channel. For variable levels, the settings of these parameters are ineffective. A correction of the gain factor is possible when the level is entered. ** These parameters are only effective in case of variable levels and have no effect in case of fixed levels. The level is set in the submenu LEVEL... (LEVEL I/Q = 0.5V/50 Ohm or VAR).
	LEVEL I GAIN	Fine adjustment of gain factor for I channel in case of fixed level. Relative gain factors in the range ±10% can be entered.
	OFFSET I FIX	Fine adjustment of level offset for the I channel in case of fixed level. The relative factors ±1.0 correspond to a an offset detuning of ±30 mV.

(SETUP...)	**OFFSET I VAR**	Fine adjustment of level offset for the I channel in case of variable level. The offset detuning depends on the of the mechanical attenuator setting of AMIQ. See AMIQ manual, section SOURce - Hardware Settings.
	LEVEL Q GAIN	Fine adjustment of gain factor for the Q channel in case of fixed level.
	OFFSET Q FIX	Fine adjustment of level offset for the Q channel in case of fixed level.
	OFFSET Q VAR	Fine adjustment of level offset for the Q channel in case of variable level.
	SKEW (Q-I)	Defining the delay between the I and Q channel. Positive values delay I compared with Q. The delay can be modified by entering the relative factors ±1.0 in a range of approx. ±1 ns at a resolution of 10 ps.
	SELF TEST ▶	Triggers the internal AMIQ selftest which comprises the following: – memory test of the output memory. – control of components of analog hardware and check of signal paths by means of the built-in diagnostic A/D converter.

SAVE/RECALL SETTINGS...	Opens a window to save/load/delete a maximum number of 100 AMIQ setups.

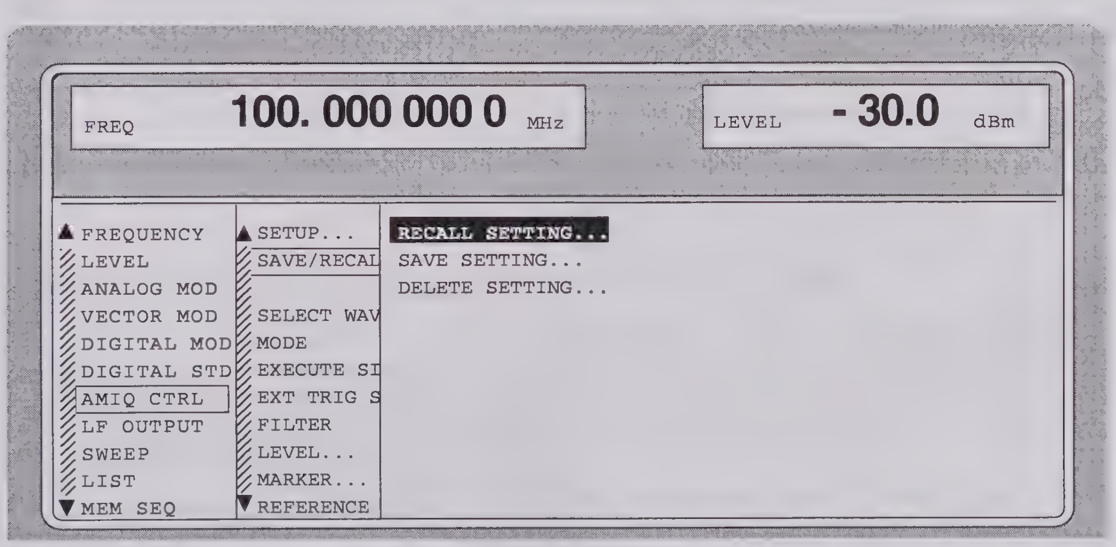


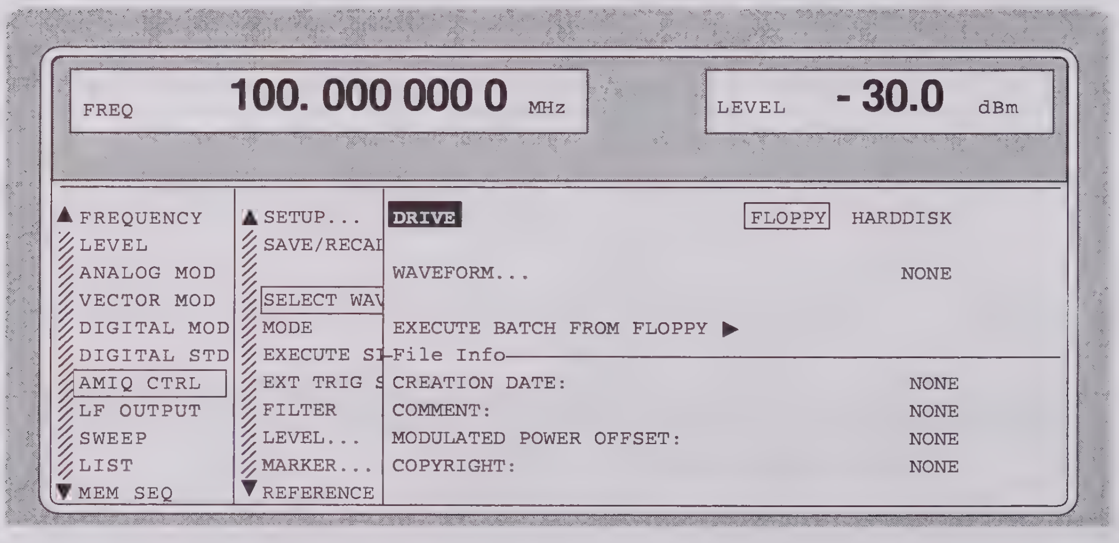
Fig. 2-176 Menu AMIQ CTRL -SAVE/RECALL SETTINGS...

(SAVE/RECALL SETTINGS...)	**RECALL SETTING...**	Selects and loads a stored AMIQ setup. The available setups are offered in a select window.

(SAVE/RECALL SETTINGS...)	**SAVE SETTING...**	Saves the current AMIQ setup. An already existing setup can be selected and overwritten in a select window. A new setup is created by selecting CREATE NEW SETTING ▶. SMIQ automatically offers SETTxx with xx being in the range from 0 to 99. This name can be modified any time as required.
	DELETE SETTING...	Deletes AMIQ setups. The available setups are offered in a select window.

SELECT WAVEFORM/ EXECUTE BATCH... Opens a window to

- load signal data from diskette or hard disk into the AMIQ internal memory,
- transfer signal data generated by WinIQSIM to the AMIQ hard disk,
- display current signal data.


FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

DRIVE FLOPPY HARDDISK

WAVEFORM... NONE

EXECUTE BATCH FROM FLOPPY ▶

File Info

CREATION DATE: NONE

COMMENT: NONE

MODULATED POWER OFFSET: NONE

COPYRIGHT: NONE

Fig. 2-177 Menu AMIQ - SELECT WAVEFORM/EXECUTE BATCH...

(SELECT WAVEFORM/ EXECUTE BATCH...)	**DRIVE**	Selects storage medium with the signal data to be activated.
	DIRECTORY...	Selects the directory comprising the required signal data on the AMIQ hard disk. The directory structure is freely selectable and can be modified with WinIQSIM. SMIQ does not allow to change the directory structure. The menu item is only visible with DRIVE = HARDDISK.

SELECT WAVEFORM/ EXECUTE BATCH...)	**WAVEFORM...**	Selects the signal data to be loaded. The data available on diskette or hard disk are offered in a select window. After selecting the signal data, the following actions are performed: 1. stopping the currently active signal output, 2. preparing the selected signal data, 3. further procedure is according to parameter MODE in main menu.
	EXECUTE BATCH FROM FLOPPY ▶	Executes the batch file WINIQSIM.IEC generated by WinIQSIM from diskette. The signal data including the given directory structure are stored on the AMIQ hard disk. The directory structure is defined by the user during the generation of the diskette.
	FILE INFO	All menu entries displayed under FILE INFO are not editable. The file info (date, comment and origin as well as power offset of modulation) from the selected files is displayed.
MODE		Configuration of trigger conditions for signal output. Any change in the trigger conditions resets the signal output and starts it again. Retriggering a running signal output is inhibited.
	OFF	Stops the signal output, output of the idle signal.
	AUTO	Continuous signal output, trigger events are ignored.
	SINGLE	Prepares a single signal output. The idle signal is output first. Signal output is started via menu item EXECUTE SINGLE ▶. After completion of the signal output, the idle signal is output. External trigger events are ignored.
	GATED	The level of the signal applied to the trigger input controls the output. If the level (HIGH/LOW) set under EXT TRIG SLOPE is applied, the signal output will be restarted and the signal will be output continuously. If the level set under EXT TRIG SLOPE is not applied, the output will be interrupted and the idle signal will be output.
	EXT-AUTO	Continuous signal output. The idle signal is output first. The signal output is started via an external trigger event. Further trigger events are ignored. A signal slope whose polarity is configured in menu item EXT TRIG SLOPE (POS/NEG) is taken as a trigger event.
	EXT-SINGLE	Prepares a single signal output. The idle signal is output first. The signal output is started via an external trigger event. After completion of the signal output, the idle signal is output until the next trigger event is obtained.
EXECUTE SINGLE ▶		Starts a single signal output. This menu item is displayed only with MODE = SINGLE.

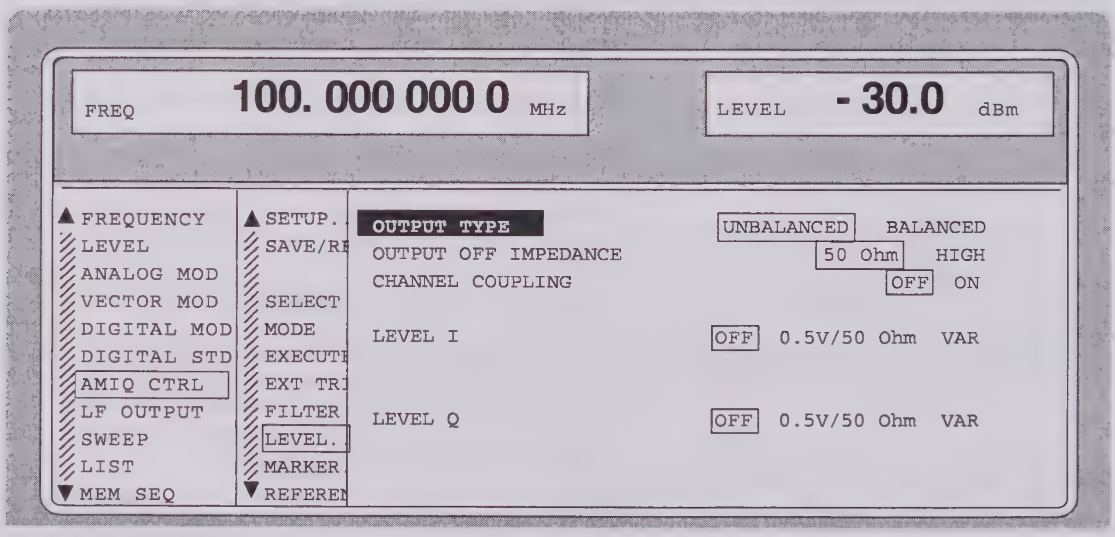
EXT TRIG SLOPE Selects the polarity of an external trigger signal at connector TRIG. This external trigger signal generates a trigger event. This setting has an effect on modes GATED (HIGH/LOW), EXT-AUTO and EXT-SINGLE (POS/NEG).

FILTER Configuration of reconstruction filters for signal paths I and Q.

OFF	Output of unfiltered I/Q signals
2.5 MHz	Loop in of the internal 2.5 MHz lowpass filter.
25 MHz	Loop in of the internal 25 MHz lowpass filter
EXT	Loop in of external bandpass filters for the I and Q channel. For a detailed specification of the filter see AMIQ manual, section Signal Inputs and Outputs.

Note: *With external filtering it has to be made sure that a filter is connected to both filter inputs I and Q on the rear of AMIQ. The two signal outputs can be switched off completely during external filtering provided that no filter is connected to the corresponding filter input.*

LEVEL... Opens a window to set the level for the two signal paths I and Q.



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

OUTPUT TYPE UNBALANCED BALANCED
OUTPUT OFF IMPEDANCE 50 Ohm HIGH
CHANNEL COUPLING OFF ON
LEVEL I OFF 0.5V/50 Ohm VAR
LEVEL Q OFF 0.5V/50 Ohm VAR

Fig. 2-178 Menu AMIQ CTRL -LEVEL...

(LEVEL...)

OUTPUT TYPE

This command switches between ground-referred outputs I and Q (UNBalanced) and differential I and Q outputs (BALanced).

UNBalanced	The level indicated for LEVEL I/Q (0 V to 1 V) is the amplitude Vp of the inner conductor of BNC connectors I and Q referred to ground, measured on a terminating impedance of 50 W.
BALanced	The level indicated for LEVEL I/Q (0 V to 4 V) is the amplitude Vpp between the inner conductors of BNC connectors I and $\overline{I}$ as well as Q and $\overline{Q}$ with a high-impedance termination.

OUTPUT OFF IMPEDANCE

This command sets the impedance of the AMIQ outputs disconnected by LEVEL I/Q=OFF, with or without option AMIQ-B2 (differential outputs). The output impedance is indicated for both channels.
If the command LEVEL I/Q != OFF is activated when the AMIQ outputs are switched on, this is equivalent to presetting which will only have an effect when the AMIQ outputs are turned off.

50	Corresponds to the setting LEVEL I/Q VAR = 0 V.
HIGH	The output connectors are isolated with a relay and become high impedance.

CHANNEL COUPLING

Switches on/off coupling of level setting for the I and Q channel.

OFF	Separate setting of the two channels
ON	Combined setting of the two channels

LEVEL I/Q

Selection of level setting for the I/Q channel.

OFF	Switch-off of output
0.5V/50Ohm	Fixed setting of 1 V_{pp} into 50 Ohm
VAR	Variable setting of level

Note: *The fine setting of level and offset can be made in menu AMIQ CTRL - SETUP....*

LEVEL

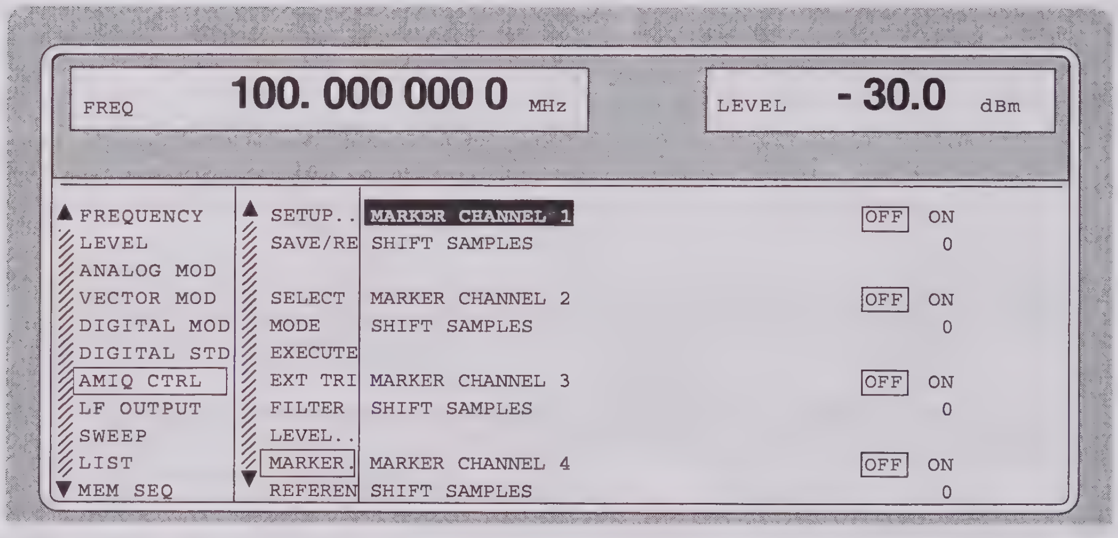
Variable setting of level for the I/Q channel. This menu item is displayed only with LEVEL I/Q = VAR.

(LEVEL) **BIAS**

DC offset in I/Q channel for the BALANCED setting. The indicated level remains the same with the I/Q output (LEVEL I/Q = OFF) turned off, provided the output impedance was prior set to 50 with the command OUTPUT OFF IMPEDANCE.
If the output impedance is set to HIGH with the I/Q output off, the output connector is isolated with a relay and the BIAS setting has no effect.
(Only with option AMIQ-B2).

MARKER...

Opens a window to configure the four binary marker outputs of AMIQ (eg to control power ramping of SMIQ), see AMIQ operating manual, section Marker Outputs.



MARKER CHANNEL 1 OFF ON
SHIFT SAMPLES 0
MARKER CHANNEL 2 OFF ON
SHIFT SAMPLES 0
MARKER CHANNEL 3 OFF ON
SHIFT SAMPLES 0
MARKER CHANNEL 4 OFF ON
SHIFT SAMPLES 0

Fig. 2-179 Menu AMIQ CTRL - MARKER...

(MARKER...) **MARKER CHANNEL 1/2/3/4**

Configuration of marker output 1/2/3/4.

OFF	No marker output
ON	Marker output
SHIFT	Marker output displaced by SHIFT SAMPLES.

SHIFT SAMPLES

Number of samples by which the marker of the corresponding marker channel is displaced. Negative values cause the marker sequence to be started earlier while positive values make for a delay of the marker sequence.

REFERENCE OSCILLATOR

Setting the synchronization by a reference clock.

INT	Use of internally generated 10 MHz clock.
EXT	The frequency can be synchronized to an external clock of 10 MHz via the REF input of AMIQ.

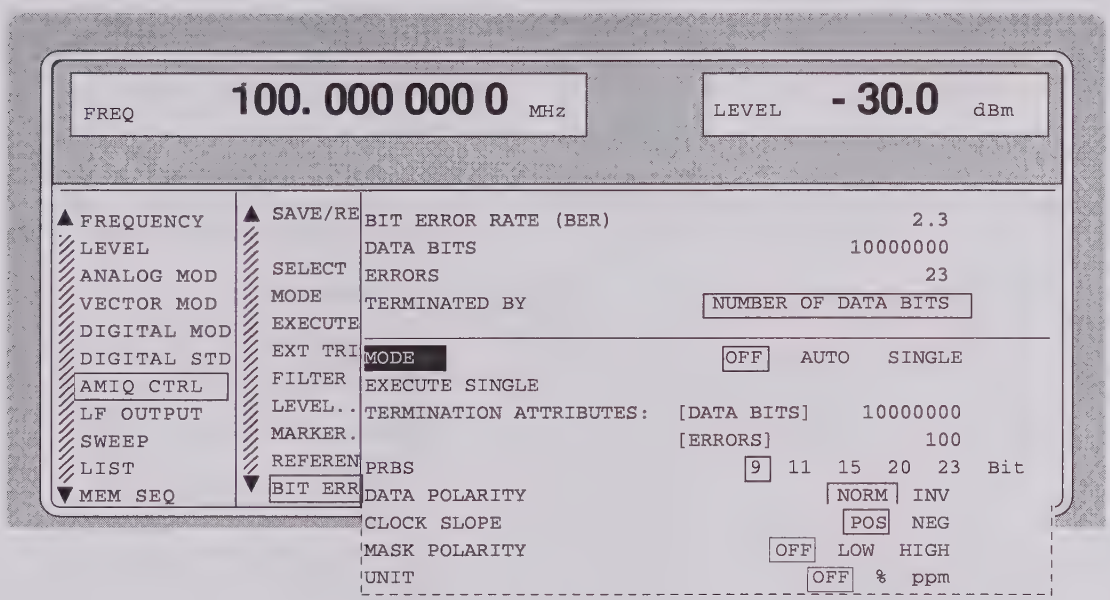
Note: *The high-precision 10 MHz clock generated by the internal reference oscillator is always output at the REF output of AMIQ.*

CLOCK

Sets a clock rate, at which samples can be read out of the output buffer and transferred to the output connectors I and Q via the D/A converters.
Range: 5 MHz to 200 MHz

BIT ERROR MEASUREMENT

This menu enables configuration and performance of BER measurement.



```
BIT ERROR RATE (BER)                                2.3
DATA BITS                                      10000000
ERRORS                                               23
TERMINATED BY                      NUMBER OF DATA BITS
MODE                                    OFF   AUTO   SINGLE
EXECUTE SINGLE
TERMINATION ATTRIBUTES:   [DATA BITS]      10000000
                          [ERRORS]              100
PRBS                                 9  11  15  20  23  Bit
DATA POLARITY                               NORM  INV
CLOCK SLOPE                                  POS  NEG
MASK POLARITY                          OFF  LOW  HIGH
UNIT                                        OFF  %  ppm
```

Fig. 2-180 Menu AMIQ CTRL – BIT ERROR MEASUREMENT...

(BIT ERROR MEASUREMENT...)

BIT ERROR RATE (BER) Cyclical indication of the BER measured by AMIQ, ie the ratio of errors occurred to the number of data bits transmitted.

DATA BITS Number of data bits transmitted so far; the indicated value is the relative number of bits referred to TERMINATION ATTRIBUTES: [DATA BITS].

ERRORS Number of errors occurred so far; the indicated value is the relative number of bits referred to TERMINATION ATTRIBUTES: [ERRORS].

TERMINATED BY The cause of the indicated measurement result is:

NUMBER OF DATA BITS	The specified number of data bits has been attained.
NUMBER OF ERRORS	The specified number of errors has been detected.
USER	User's manual interruption of the measurement
----	Measurement in progress

(BIT ERROR MEASUREMENT...)	**MODE**		Setting the operating mode for the BER measurement.
		OFF	Terminating measurement.
		AUTO	Continuous BER measurement. If one or both termination criteria are met, a new measurement is initiated. SMIQ cyclically fetches the current measurement results from AMIQ. A measurement can take considerable time, depending on the settings made. During the first measurement, the intermediate results are displayed. For all further measurements, only the final results are shown (by AMIQ). The DATA BITS and ERRORS displayed are continuously updated and indicate the relative values referred to the current measurement.
		SINGLE	Single BER measurement. SMIQ cyclically fetches the current measurement results from AMIQ while the measurement is being performed. If one of the termination criteria is met (TERMINATION ATTRIBUTES: [DATA BITS] and TERMINATION ATTRIBUTES: [ERRORS]), the measurement is terminated. A SINGLE measurement can only be initiated by selecting the EXECUTE SINGLE menu.
	EXECUTE SINGLE ▶		Initiating a single BER measurement. This menu item is only shown if MODE = SINGLE has been set.
	TERMINATION ATTRIBUTES:	**[DATA BITS]**	Setting the termination criterion „Number of data bits transmitted“
		[ERRORS]	Setting the termination criterion „Maximum number of errors occurred“
	PRBS		Setting the data period length 9, 11, 15, 20, 23 bits.
	DATA POLARITY		Setting the polarity of the data bits.
		NORM	Normal polarity
		INV	Inverted polarity
	CLOCK SLOPE		Setting the polarity of the clock slopes.
		POS	Rising slope
		NEG	Falling slope
	MASK POLARITY		Setting the polarity of the DUT's Data Valid signal. 3 possibilities: OFF, LOW and HIGH.
	UNIT		Setting the unit for indicating the BIT ERROR RATE.
		OFF	Indication without unit, decadic
		%	Indication of relative frequency in per cent
		ppm	Indication of relative frequency in thousandths

2.20 Noise Generator and Distortion Simulator

The noise generator and the distortion simulator (Option SMIQB17) perform the following two functions:

- Addition of noise to SMIQ output level. Since the C/N can be finely varied, different reception conditions can be realistically simulated.
- Simulation of TWTA (Traveling Wave Tube Amplifier) distortion of satellite. The signal received by the satellite is strongly distorted and thus more difficult to demodulate than an undistorted signal. Real reception conditions can be simulated with the distortion simulator and the receivers can thus be tested realistically.

The noise generator outputs an AWGN signal (Additive White Gaussian Noise) , ie the noise power ratio is Gaussian-distributed and the noise signal is added to the signal.

Distortion is performed via AM/AM conversion and AM/PM conversion. The respective characteristics can be loaded or modified via IEC/IEEE bus.

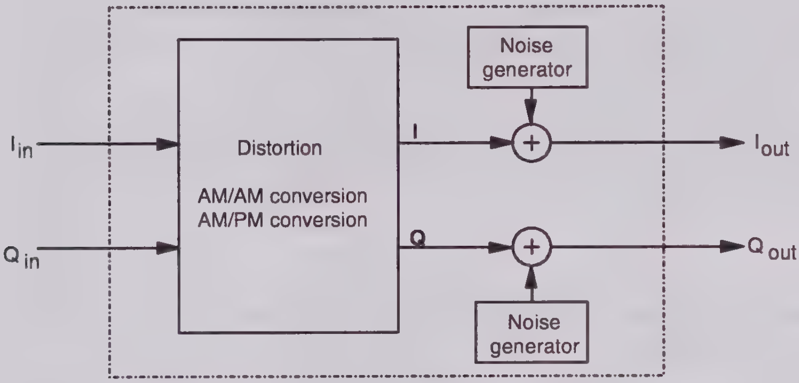


Fig. 2-181 Block diagram of noise generator and distortion simulator

The noise generator and distortion simulator are independant functional units and can be operated separately. They exclusively use baseband signals I and Q. Both external I/Q signals and I/Q signals internally generated by the modulation coder can be distorted and superimposed with noise. The noise generator can also be switched on if internal and external modulation are switched off. The unmodulated carrier is then superimposed with the noise signal.

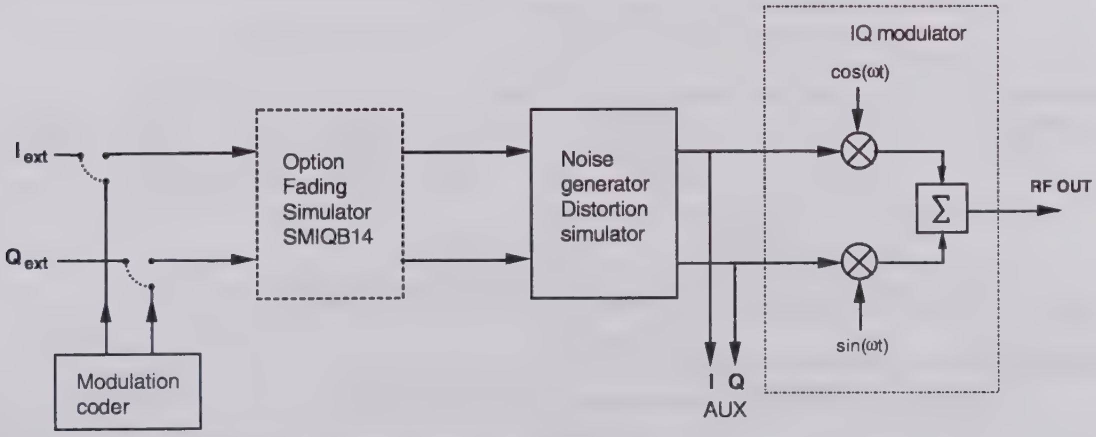


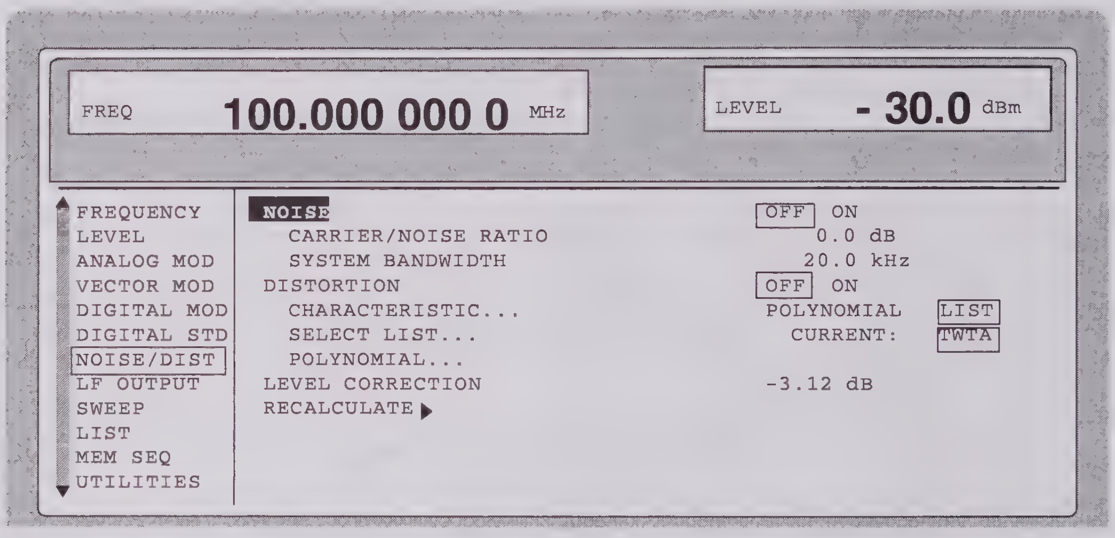
Fig. 2-182 Noise generator and distortion simulator in SMIQ

2.20.1 Setting NOISE/DIST Menu

The NOISE/DIST menu comprises all the settings of the noise generator and the distortion simulator. For calibration of the noise generator and the distortion simulator, see Chapter 2, Section Calibration VECTOR MOD.

Note: Functions NOISE/DIST and BB-AM cannot be set at the same time and switch off mutually.

Menu selection: NOISE/DIST



```
FREQ    100.000 000 0 MHz                         LEVEL    - 30.0 dBm

FREQUENCY    | NOISE                              OFF  ON
LEVEL        |   CARRIER/NOISE RATIO                0.0 dB
ANALOG MOD   |   SYSTEM BANDWIDTH                  20.0 kHz
VECTOR MOD   | DISTORTION                         OFF  ON
DIGITAL MOD  |   CHARACTERISTIC...                 POLYNOMIAL  LIST
DIGITAL STD  |   SELECT LIST...                      CURRENT:  TWTA
NOISE/DIST   |   POLYNOMIAL...
LF OUTPUT    | LEVEL CORRECTION                    -3.12 dB
SWEEP        | RECALCULATE ▶
LIST         |
MEM SEQ      |
UTILITIES    |
```

Fig. 2-183 Menu NOISE/DIST (presetting)

NOISE Switch on/off of noise source. The noise source is an AWGN (Additive White Gaussian Noise) signal.

IEC/IEEE-bus commands `:SOUR:NOIS ON`

CARRIER/NOISE RATIO Input value of the carrier-to-noise ratio. Setting range is 5.0 to 30 dB. When changing the CARRIER/NOISE RATIO, the noise power is changed as well but the carrier power remains unchanged. The carrier power is the power displayed in the header under LEVEL.

IEC/IEEE-bus command `:SOUR:NOIS:SNR 10 dB`

SYSTEM BANDWIDTH Input value of system bandwidth.
The system bandwidth is the HF-bandwidth by which the noise power is calculated. The bandwidth of the generated noise can only be set in steps. The set bandwidth is to be 1.4 times the system bandwidth at minimum and 10 MHz at maximum.

Setting range: 10 kHz to 10 MHz;
Resolution: three digits

IEC/IEEE-bus command `:SOUR:NOIS:BAND 1.23 MHz`

DISTORTION Switch on/off of distortion.

IEC/IEEE-bus command `:SOUR:DIST ON`

CHARACTERISTIC... Switchover between distortion data from the polynomial and list. Under polynomial the distortion data are calculated from the coefficients entered into the polynomial menu. Under list they are calculated according to the characteristic transferred via the IEC/IEEE-bus and selected under SELECT LIST.

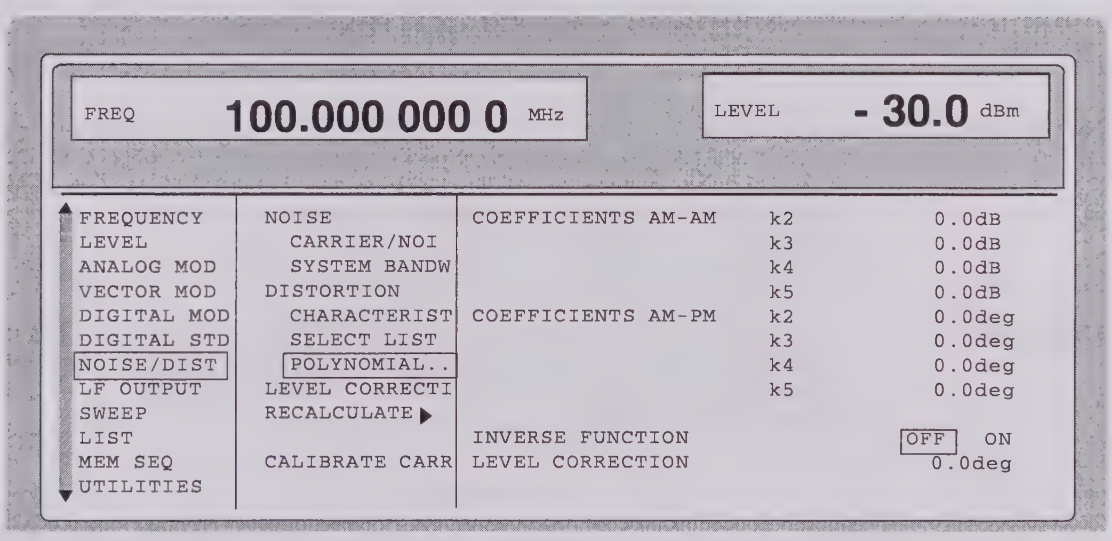
IEC/IEEE-bus command `:SOUR:DIST:MODE POLY | DATA`

SELECT LIST... Opens a window for selecting the distortion characteristics. Several distortion characteristics can be stored in the memory at the same time.

IEC/IEEE-bus command `:SOUR:DIST:DATA:SEL "TWTA"`

POLYNOMIAL... Opens a window for entering the polynomial parameters.

Menu selection: NOISE/DIST - POLYNOMIAL...



FREQ 100.000 000 0 MHz

LEVEL - 30.0 dBm

COEFFICIENTS AM-AM	k2	0.0dB
	k3	0.0dB
	k4	0.0dB
	k5	0.0dB
COEFFICIENTS AM-PM	k2	0.0deg
	k3	0.0deg
	k4	0.0deg
	k5	0.0deg
INVERSE FUNCTION		OFF ON
LEVEL CORRECTION		0.0deg

Fig. 2-184 Menu NOISE/DIST - POLYNOMIAL...

(POLYNOMIAL...)

COEFFICIENT AM-AM Entry of polynomial coefficients k2 to k5 for the AM-AM distortion in dB. The polynomial has the following form:

Aout = Ain + n2*Ain^2 + n3*Ain^3 + n4*Ain^4 + n5*Ain^5

with n<i> = 10^(k<i>/20) - 1, i = 2, 3, 4, 5
Normalization: Aout_n= 0 ... 1, Ain = 0...1
The coefficient n0 is always 0 and n1 is always 1.
Value range: -10.0 to +10.0 dB

IEEE-bus `:SOUR:DIST:POLY:AMAM:K2 -2 DB`

COEFFICIENT AM-PM Entry of polynomial coefficients k2 to k5 for the AM-PM distortion in degrees. The polynomial has the following form:

Pout = Pin + k2*Ain^1 + k3*Ain^2 + k4*Ain^3 + k5*Ain^4

The coefficients K0 and K1 are always 0.
Value range: - 60.0 to + 60.0 degrees.

IEEE-bus `:SOUR:DIST:POLY:AMPM:K3 -45 DEG`

(POLYNOMIAL...)

INVERSE FUNCTION

Compensation of an amplifier connected after the SMIQ, the coefficients entered correspond to the measured distortion of the amplifier.

OFF The above equations are applicable.

ON AM-AM distortion:
inverse funtion of Aout_n (Ain),
AM-PM distortion:
Pout = Pin - k2*Aout_n(Ain)^1 - k3*Aout_n(Ain)^2 - k4*Aout_n(Ain)^3 - k5*Aout_n(Ain)^4

IEEE-bus `:SOUR:DIST:POLY:IFUN ON`

LEVEL CORRECTION

Entry of the level correction for the polynomial. The value entered is active and is displayed in the main menu after selection of the polynomial and calling up RECALCULATE. It can be edited only here.
Value range: -20 dB to +6 dB

IEEE-bus `:SOUR:DIST:POLY:LEV:CORR -10 DB`

LEVEL CORRECTION

Display of level correction to correct the output level so that the attenuation or gain of the distortion simulator can be compensated. For the polynomial the level correction can be entered into submenu POLYNOMIAL. The level correction for the lists can only be transferred via the IEC/IEEE bus.
Value range: -20 dB to +6 dB

IEC/IEEE-bus command `:SOUR:DIST:DATA:LEV:CORR -3.12 DB`

RECALCULATE ▶

Distortion data are active since as they are transferred into the module. This is necessary when the available characteristic has been overwritten via the IEC/IEEE bus or when a polynomial parameter has been modified.

IEC/IEEE-bus command `:SOUR:DIST:REC`

2.20.2 Loading New Distortion Characteristics

SMIQ is supplied with a preset distortion characteristic that corresponds to the typical characteristic of a traveling wave tube amplifier in WorldSpace satellites. The name of the characteristic set as standard is TWTA (Traveling Wave Tube Amplifier). Other user-defined distortion characteristics can also be stored in SMIQ. If several characteristics are stored, they can be selected under SELECT CHARACTERISTIC... .

A new characteristic is formed by the interpolation points of AM/AM and AM/PM conversion. Entry is possible via IEC/IEEE bus. SMIQ determines the complete characteristic based on these interpolation points by cubic spline interpolation. The factory-set characteristics (TWTA) of AM/AM and AM/PM conversion are shown in the following figures. The continuous line indicates the interpolated characteristic. The circles show the reference points. The input values are on the x-axis, the output values on the y-axis.

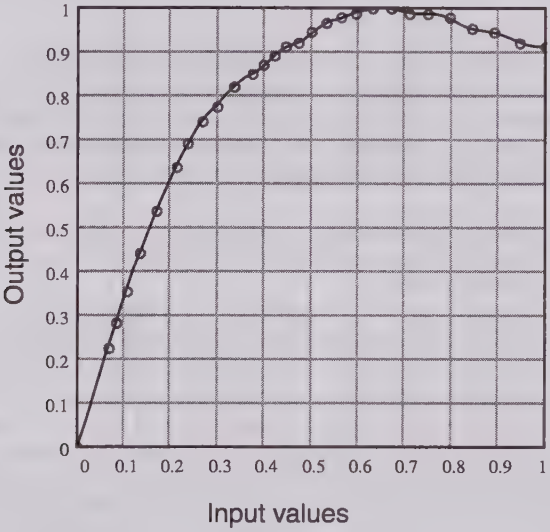


Fig. 2-185 AM/AM conversion

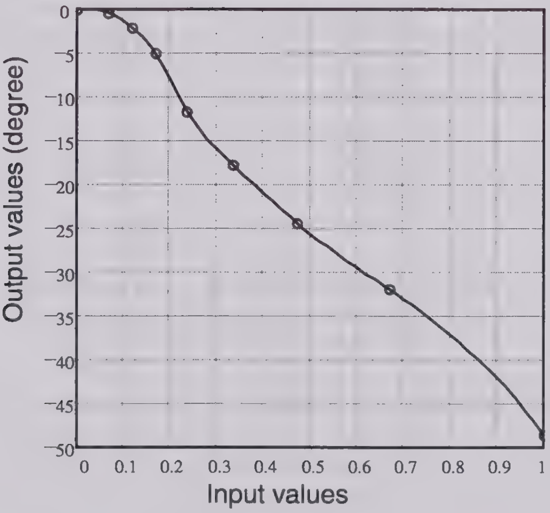


Fig. 2-186 AM/PM conversion

The two characteristics are formed by 2 data fields, the x-axis and the y-axis. 4 data fields therefore have to be loaded for a new distortion characteristic. The minimum number of interpolation points that can be entered for a characteristic is 5, the maximum number is 30. The limit values for the data fields are as follows:

Input values (x-axis) of AM/AM conversion:	-100 dB to 0 dB
Output values (y-axis) of AM/AM conversion:	-100 dB to 0 dB
Input values (x-axis) of AM/PM conversion:	-100 dB to 0 dB
Output values (y axis) of AM/PM conversion:	-180° to +180°

2.20.3 Level Correction of the Distortion Simulator

The level correction influences the level if digital modulation is switched on (not with VECTOR MOD ON) and the distortion simulator is active.

For the rms level set as LEVEL to appear at the RF output, the level control has to compensate for the attenuation or gain of the distortion characteristic. For this purpose, level correction (-20 dB to 6 dB) stored under the previously selected name is transmitted via IEC/IEEE-bus command. If this characteristic is active, the output level is increased or decreased by the level-correction value. The value by which the level is increased or decreased is indicated under LEVEL CORRECTION.

As the attenuation/gain of the distortion characteristic is dependent on the type of input signal being dealt with, the level correction applies only to one particular type of digital modulation (modulation type, filter type and filter parameters) and fading setting.
For the characteristic TWTA, for instance, which is supplied as standard, -3.12 dB is stored as level correction. This value only applies to "WorldSpace Modulation" (QPSK, SQR-COS/0.4).

For the determination of level correction through measurement, the parameter is at first set to 0 dB via IEC/IEEE bus. The desired type of digital modulation is then set, and the characteristic TEST (linear characteristic supplied, LEVEL CORRECTION = 0 dB) activated, followed by the new characteristic. The level difference of the two characteristics is measured at the RF output by means of an RF level meter. The level correction for the new characteristic is then adjusted to the level difference measured via IEC/IEEE bus. If the level difference is measured again, the result should be 0 dB ± 0.1 dB.

As theoretically the characteristic gain (negative level correction) cannot exceed the crest factor of the modulation used, the warning "Warning 426 Absolute value of level correction > crest factor of Digital Mod;" is displayed if the magnitude of the negative level correction exceeds the crest factor. The correction is also restricted to the crest factor when the level is set, so LEVEL and PEP are identical.

Step-by-step instruction to enter a new distortion characteristic via IEC/IEEE bus:

1. **Enter the name of a new characteristic**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:DATA:SEL "TWTA1"
   ```

   The characteristic is listed under a freely selectable name (max. 8 characters) in the select menu that comprises different characteristics.

2. **Enter the data field for input values (x-axis) of AM/AM conversion in dB**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:DATA:AMB -23.5,-21.5,
   -19.5,-17.5,-15.5,-13.5,-12.5,-11.5,
   -10.5,-9.5,-8.5,-8,-7.5,-7,-6.5,-6,
   -5.5,-5,-4.5,-4,-3.5,-3,-2.5,-2,-1.5,
   -1,-0.5,0
   ```

3. **Enter the data field for output values (y-axis) of AM/AM conversion in dB**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:DATA:AM -12.9,-10.9,-9,
   -7.1,-5.4,-3.9,-3.2,-2.6,-2.2,-1.7,
   -1.4,-1.2,-1,-0.8,-0.7,-0.5,-0.3,
   -0.2,-0.1,0,0,-0.1,-0.1,-0.2,-0.4,
   -0.5,-0.7,-0.8
   ```

4. **Enter the data field for input values (x-axis) of AM/PM conversion in dB**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:DATA:PMB -23.5,-18.5,
   -15.5,-12.5,-9.5,-6.5,-3.5,0
   ```

5. **Enter the data field for output values (y-axis) of AM/PM conversion in degrees**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:DATA:PM 0,-2.1,-5,-11.6,
   -17.7,-24.4,-31.9,-48.6
   ```

6. **Enter the level correction**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:DATA:LEV:CORR -3.12
   ```

7. **Data transmission to the module**

   IEC/IEEE-bus command

   ```
   :SOUR:DIST:REC
   ```

Note: *The values of the above example correspond to the TWTA characteristic that is supplied.*

2.20.4 Calculation of the Distortion Characteristic from Polynomial Equations

A characteristic can be defined by entering polynomial coefficients in submenu POLYNOMIAL instead of transferring reference values via the IEC/IEEE bus. The characteristic is calculated and loaded from the four polynomial coefficients for AM-AM and AM-PM using the equations specified under section 2.20.1. An IEC/IEEE-bus transfer is not required in this case.

It is possible to compensate the distortion of an amplifier connected after the SMIQ using the INVERSE FUNCTION.
The characteristic entered via polynomial coefficients should be identical to the distortion characteristic of the amplifier.

The level correction described in section 2.20.3 can be directly entered in the POLYNOMIAL menu. If the polynomial is activated, this value can be displayed and set in the NOISE/DIST menu under LEVEL CORRECTION. The determination by measurement of the level correction is performed as described in section 2.20.3.

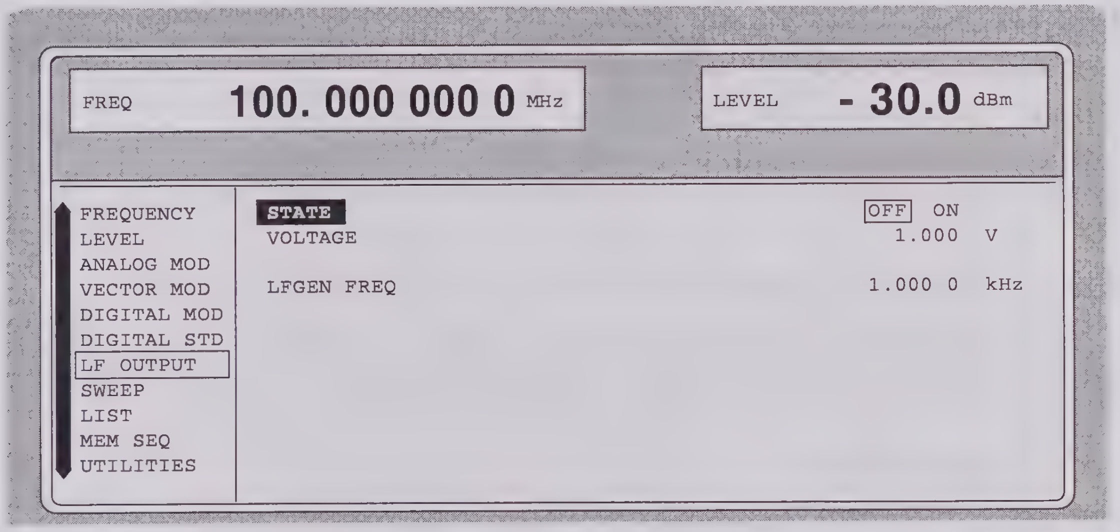
2.21 LF-Output

The internal LF generator is available as a signal source for the LF output.

Menu LF OUTPUT offers access to the settings of the LF output.

Notes:
- *An alteration of the frequency of the internal modulation generator in the LF-output menu automatically effects the modulation for which the generator is selected as modulation source.*
- *The SWEEP function of LF generator can be activated in menu SWEEP-LF-GEN.*

Menu selection: LF OUTPUT



```
STATE                                   OFF  ON
VOLTAGE                                  1.000   V

LFGEN FREQ                              1.000 0  kHz
```

Fig. 2-187 Menu LF OUTPUT (preset setting)

STATE	Switching on/off the LF output. Parameter STATE has no influence on the modulation settings. IEC/IEEE-bus command `:OUTP2 ON`
VOLTAGE	Input value of the output voltage of the LF output. The input is effected in the form of a peak voltage. IEC/IEEE-bus command `:OUTP2:VOLT 1V`
LFGEN FREQ	Input value of the frequency of internal modulation generator. IEC/IEEE-bus command `:SOUR2:FREQ 1kHz`

2.22 Sweep

The SMIQ offers a digital step-by-step sweep for parameters:

- RF frequency
- LF frequency
- RF level

Setting a sweep is effected in five basic steps which are shown in the following example, the setting of a frequency sweep:

1. Set sweep range (START and STOP or CENTER and SPAN).
2. Select linear or logarithmic sequence (SPACING).
3. Set step width (STEP) and dwell time (DWELL).
4. Activate marker if desired (MARKER).
5. Switch on sweep (MODE set to AUTO, SINGLE or STEP).

2.22.1 Setting the Sweep Range (START, STOP, CENTER and SPAN)

The sweep range of the RF sweep can be entered in two different ways. Either by entering the START and STOP value or by entering CENTER and SPAN. Please observe that the two parameter sets influence one another. The influence is exerted in the following way:

START frequency altered:
STOP = unaltered
CENTER = (START + STOP)/2
SPAN = (STOP - START)

STOP frequency altered:
START = unaltered
CENTER = (START + STOP)/2
SPAN = (STOP - START)

CENTER frequency altered
SPAN = unaltered
START = (CENTER - SPAN/2)
STOP = (CENTER + SPAN/2)

SPAN frequency altered:
CENTER = unaltered
START = (CENTER - SPAN/2)
STOP = (CENTER + SPAN/2)

2.22.2 Selecting the Sweep Run (SPACING LIN, LOG)

The sweep run, linear or logarithmic, can be selected using SPACING. For the RF and LF sweep, a linear or logarithmic run is possible. For level sweep, only the logarithmic run is possible.

With the logarithmic sweep, step width STEP is equal to a constant fraction of the present setting. The logarithmic step width is entered in unit % with RF or LF sweep, in unit dB with level sweep.

2.22.3 Operating Modes (MODE)

The following sweep operating modes are available:

AUTO

Sweep from the starting point to the stop point, with automatic restart at the starting point. If another sweep operating mode was activated prior to the AUTO operating mode, continuation is made from the current sweep setting.

IEC/IEEE-bus commands:

RF sweep:	LF sweep:	Level sweep:
`SOUR:FREQ:MODE SWE`	`SOUR2:FREQ:MODE SWE`	`SOUR:POW:MODE SWE`
`SOUR:SWE:MODE AUTO`	`SOUR2:SWE:MODE AUTO`	`SOUR:SWE:POW:MODE AUTO`
`TRIG:SOUR AUTO`	`TRIG2:SOUR AUTO`	`TRIG:SOUR AUTO`

SINGLE

Single run from the starting point to the stop point. If SINGLE is selected, the run is not started yet. Function EXECUTE SINGLE SWEEP ▶ to be executed, which can be used to start the run, is displayed below the MODE line.

IEC/IEEE-bus commands:

RF sweep:	LF sweep:	Level sweep:
`SOUR:FREQ:MODE SWE`	`SOUR2:FREQ:MODE SWE`	`SOUR:POW:MODE SWE`
`SOUR:SWE:MODE AUTO`	`SOUR2:SWE:MODE AUTO`	`SOUR:SWE:POW:MODE AUTO`
`TRIG:SOUR SING`	`TRIG2:SOUR SING`	`TRIG:SOUR SING`

STEP

Step-by-step, manual run within the sweep limits. Activating STEP stops a running sweep and the cursor wraps to the indication value of CURRENT. The sweep run can now be controlled upwards or downwards in discrete steps using the rotary knob or the numeric keys.

IEC/IEEE-bus commands:

RF sweep:	LF sweep:	Level sweep:
`SOUR:FREQ:MODE SWE`	`SOUR2:FREQ:MODE SWE`	`SOUR:POW:MODE SWE`
`SOUR:SWE:MODE STEP`	`SOUR2:SWE:MODE STEP`	`SOUR:SWE:POW:MODE STEP`
`TRIG:SOUR SING`	`TRIG2:SOUR SING`	`TRIG:SOUR SING`

EXT-SINGLE

Single run from the starting point to the stop point as in the case of SINGLE, but triggered by an external trigger signal.

IEC-bus short commands:

RF sweep:	LF sweep:	Level sweep:
`SOUR:FREQ:MODE SWE`	`SOUR2:FREQ:MODE SWE`	`SOUR:POW:MODE SWE`
`SOUR:SWE:MODE AUTO`	`SOUR2:SWE:MODE AUTO`	`SOUR:SWE:POW:MODE AUTO`
`TRIG:SOUR EXT`	`TRIG2:SOUR EXT`	`TRIG:SOUR EXT`

EXT-STEP Step-by-step run by means of the external trigger signal. Each trigger event triggers a single step.

IEC-bus short commands:

RF sweep:	LF sweep:	Level sweep:
`SOUR:FREQ:MODE SWE`	`SOUR2:FREQ:MODE SWE`	`SOUR:POW:MODE SWE`
`SOUR:SWE:MODE STEP`	`SOUR2:SWE:MODE STEP`	`SOUR:SWE:POW:MODE STEP`
`TRIG:SOUR EXT`	`TRIG2:SOUR EXT`	`TRIG:SOUR EXT`

OFF The sweep operating mode is switched off.

IEC-bus short commands:

RF sweep:	LF sweep:	Level sweep:
`SOUR:FREQ:MODE CW`	`SOUR2:FREQ:MODE CW`	`SOUR:POW:MODE CW`

2.22.4 Trigger Input

An external signal at the rear input triggers the sweep in the EXT-SINGLE and EXT-STEP operating modes. The polarity of the active trigger edge can be set in menu UTILITIES - AUX I/O EXT TRIG SLOPE .

2.22.5 Sweep Outputs

Outputs X-AXIS, BLANK and MARKER are available at the rear of the instrument to control and trigger oscilloscopes or XY recorders.

X_AXIS With sweep switched on, this output supplies a voltage ramp of 0 to 10 V for the X-deflection of an oscilloscope or an XY recorder.

BLANK This output supplies a signal (0V/5V) to trigger and blank an oscilloscope or for the PEN LIFT control of an XY recorder. The polarity and the period of the signal can be set under UTILITIES - AUX I/O - BLANK POLARITY and - BLANK TIME.

MARKER This output becomes active when the sweep run has reached the mark. The MARKER signal can be used for the brightness control of an oscilloscope. Up to three marks can be set in order to mark certain positions in the sweep run. The polarity of the signal can be set in menu UTILITIES - AUX I/O - MARKER POLARITY. The period of the active signal is equal to the dwell time (DWELL) of a step.

Signal examples:

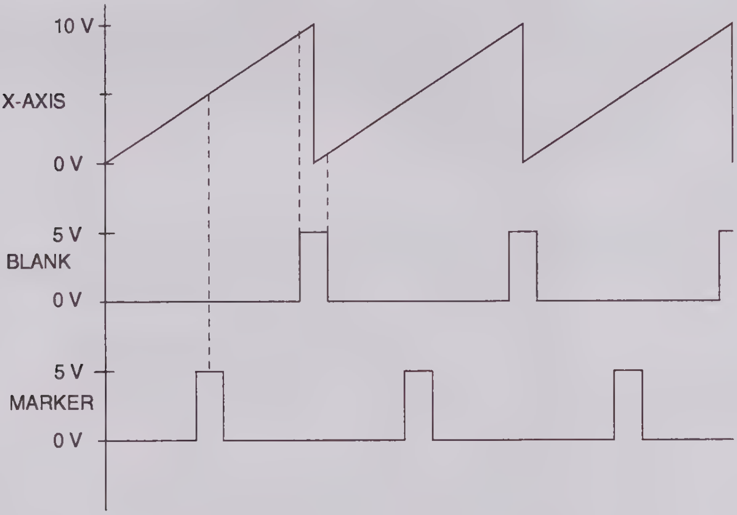


Fig. 2-188 Signal example sweep: MODE = AUTO, BLANK TIME = NORMAL

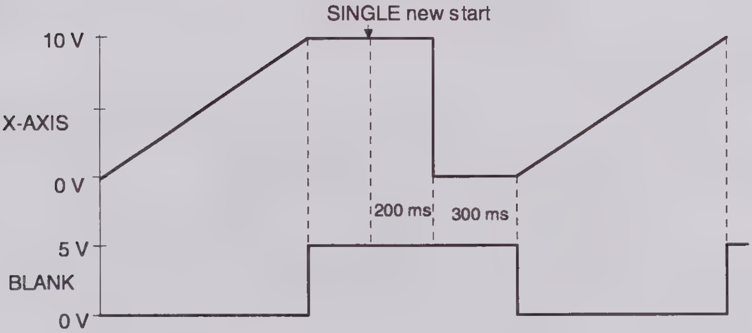
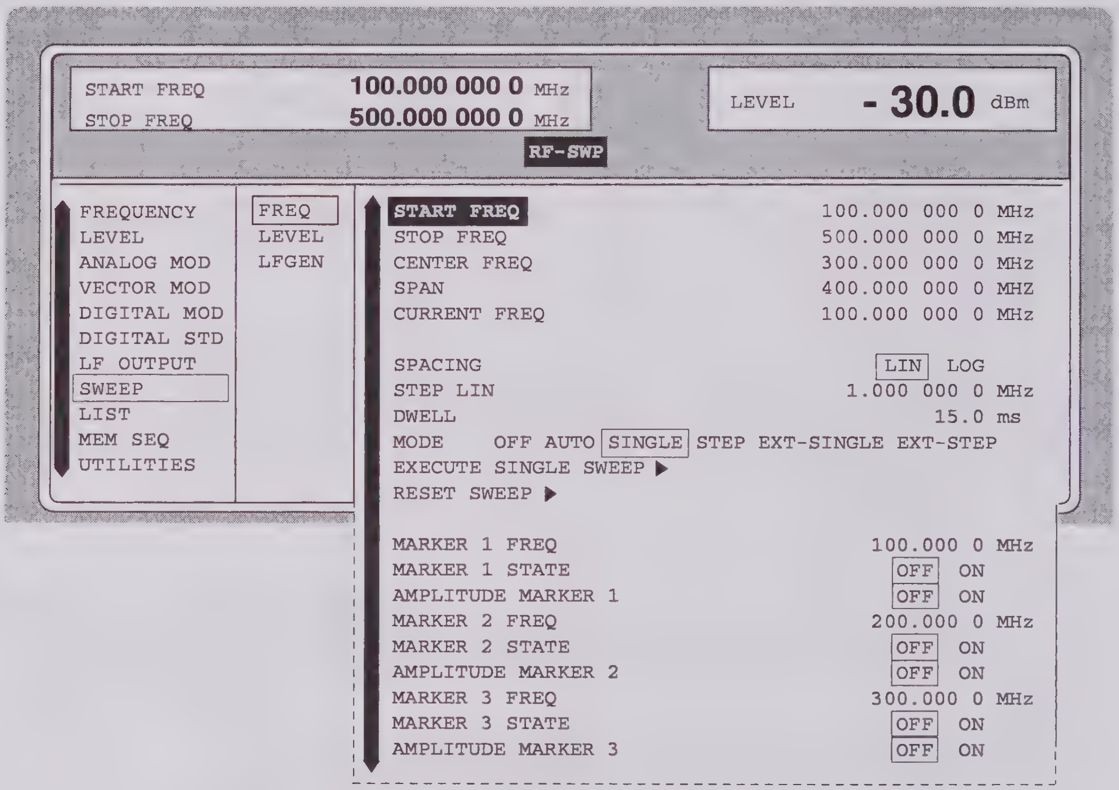


Fig. 2-189 Signal example sweep: MODE = SINGLE, BLANK TIME = LONG

2.22.6 RF-Sweep

Menu SWEEP - FREQ offers access to settings for RF sweep.

Menu selection: SWEEP - FREQ



```
START FREQ    100.000 000 0 MHz          LEVEL   - 30.0 dBm
STOP FREQ     500.000 000 0 MHz

START FREQ                                    100.000 000 0 MHz
STOP FREQ                                     500.000 000 0 MHz
CENTER FREQ                                   300.000 000 0 MHz
SPAN                                          400.000 000 0 MHZ
CURRENT FREQ                                  100.000 000 0 MHz

SPACING                                              LIN  LOG
STEP LIN                                        1.000 000 0 MHz
DWELL                                                   15.0 ms
MODE     OFF AUTO SINGLE STEP EXT-SINGLE EXT-STEP
EXECUTE SINGLE SWEEP ▶
RESET SWEEP ▶

MARKER 1 FREQ                                     100.000 0 MHz
MARKER 1 STATE                                          OFF  ON
AMPLITUDE MARKER 1                                      OFF  ON
MARKER 2 FREQ                                     200.000 0 MHz
MARKER 2 STATE                                          OFF  ON
AMPLITUDE MARKER 2                                      OFF  ON
MARKER 3 FREQ                                     300.000 0 MHz
MARKER 3 STATE                                          OFF  ON
AMPLITUDE MARKER 3                                      OFF  ON
```

Fig. 2-190 Menu SWEEP - FREQ

START FREQ	Input value of the starting frequency. IEC/IEEE-bus command `:SOUR:FREQ:STAR 100MHz`
STOP FREQ	Input value of the stop frequency. IEC/IEEE-bus command `:SOUR:FREQ:STOP 500MHz`
CENTER FREQ	Input value of the center frequency. IEC/IEEE-bus command `:SOUR:FREQ:CENT 300MHz`
SPAN	Input value of the span. IEC/IEEE-bus command `:SOUR:FREQ:SPAN 100MHz`
CURRENT FREQ	Indication of the current frequency value. Operating mode STEP: Input value of the frequency.

STEP LIN (LOG)

Input value of the step width. Depending on whether SPACING LIN or LOG is selected, STEP LIN or STEP LOG is displayed.

IEC/IEEE-bus command `:SOUR:SWE:STEP:LIN 1MHz`

DWELL

Input value of the dwell time per step.

IEC/IEEE-bus command `:SOUR:SWE:DWEL 10ms`

SPACING

Input value of the dwell time per step.

IEC/IEEE-bus command `SOUR:SWE:SPAC LIN`

MODE

Selection of the sweep operating mode.

IEC/IEEE-bus commands

```
:SOUR:FREQ:MODE SWE;
:SOUR:SWE:MODE AUTO;
:TRIG:SOUR SING
```

EXECUTE SINGLE SWEEP ▶

Starts a single sweep run. This action to be executed is only indicated and is only effective if MODE SINGLE has been selected.

IEC/IEEE-bus command `:TRIG`

RESET SWEEP ▶

Sets the starting frequency.

IEC/IEEE-bus command `:ABOR`

MARKER 1 FREQ
MARKER 2 FREQ
MARKER 3 FREQ

Input value of the frequency for the marker selected

IEC/IEEE-bus command `:SOUR:MARK1:FREQ 100MHz`

MARKER 1 STATE
MARKER 2 STATE
MARKER 3 STATE

Switching on/off the marker selected

IEC/IEEE-bus command `:SOUR:MARK1 OFF`

AMPLITUDE MARKER1
AMPLITUDE MARKER 2
AMPLITUDE MARKER 3

Switching on/off the amplitude marker selected

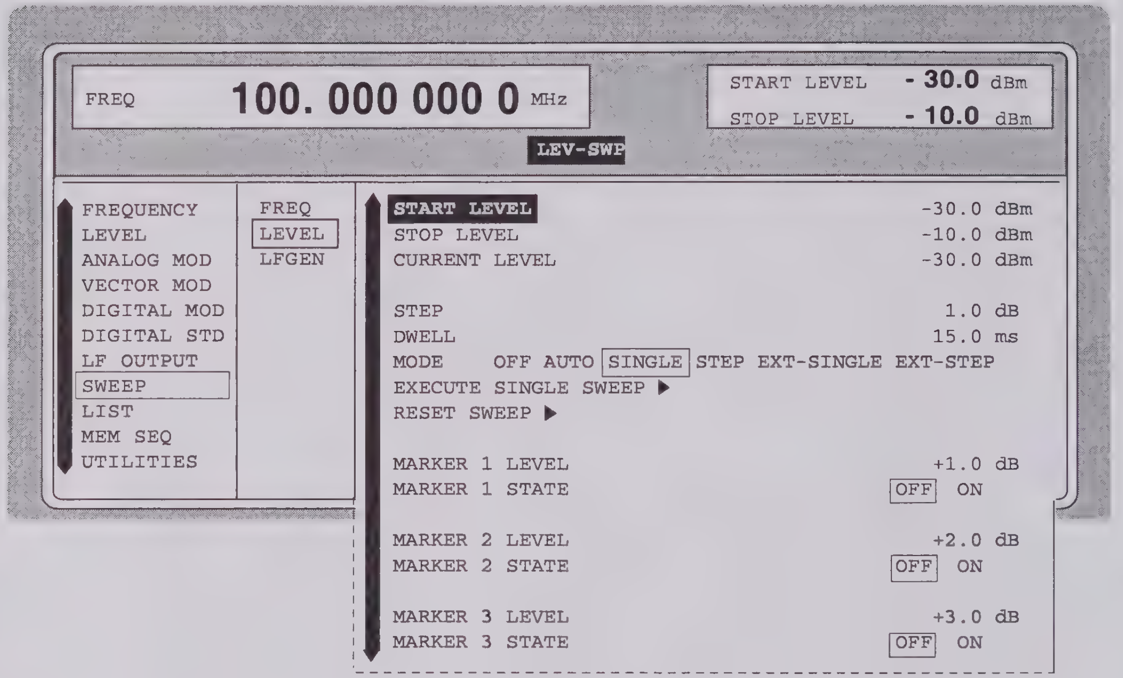
OFF	Input value of the frequency for the marker selected
ON	Amplitude marker is switched on. On reaching the mark the output level is reduced by 1 dB.

IEC/IEEE-bus command `:SOUR:MARK1:AMPL OFF`

2.22.7 LEVEL Sweep

Menu SWEEP - LEVEL offers access to settings for LEVEL sweep.

Menu selection: SWEEP - LEVEL



FREQ 100. 000 000 0 MHz

START LEVEL - 30.0 dBm
STOP LEVEL - 10.0 dBm

START LEVEL -30.0 dBm
STOP LEVEL -10.0 dBm
CURRENT LEVEL -30.0 dBm

STEP 1.0 dB
DWELL 15.0 ms
MODE OFF AUTO [✓ SINGLE] STEP EXT-SINGLE EXT-STEP

MARKER 1 LEVEL +1.0 dB
MARKER 1 STATE [✓ OFF] ON

MARKER 2 LEVEL +2.0 dB
MARKER 2 STATE [✓ OFF] ON

MARKER 3 LEVEL +3.0 dB
MARKER 3 STATE [✓ OFF] ON

Fig. 2-191 Menu SWEEP - LEVEL

START LEVEL	Input value of the starting level. IEC/IEEE-bus command `:POW:STAR -30dBm`
STOP LEVEL	Input value of the stop levell. IEC/IEEE-bus command `:SOUR:POW:STOP -10dBm`
CURRENT LEVEL	Indication of the current level. Operating mode STEP: Input value of the level.
STEP	Input value of the step width. IEC/IEEE-bus command `:SOUR:SWE:POW:STEP 1dB`
DWELL	Input value of the dwell time per step IEC/IEEE-bus command `:SOUR:SWE:POW:DWEL 15ms`

MODE	Selection of the sweep operating mode.
	IEC/IEEE-bus commands `:SOUR:POW:MODE SWE;`
	`:SOUR:SWE:POW:MODE AUTO;`
	`:TRIG:SOUR SING`

EXECUTE SINGLE SWEEP ▶

Starts a single sweep run. This action to be executed is only indicated and is only effective if MODE SINGLE is selected.

IEC/IEEE-bus command `:TRIG`

RESET SWEEP ▶

Sets the starting level.

IEC/IEEE-bus command `:ABOR`

MARKER 1 LEVEL
MARKER 2 LEVEL
MARKER 3 LEVEL

Input value of the level for the marker selected.

IEC/IEEE-bus command `:SOUR:MARK1:PSW:POW 0dBm`

MARKER 1 STATE
MARKER 2 STATE
MARKER 3 STATE

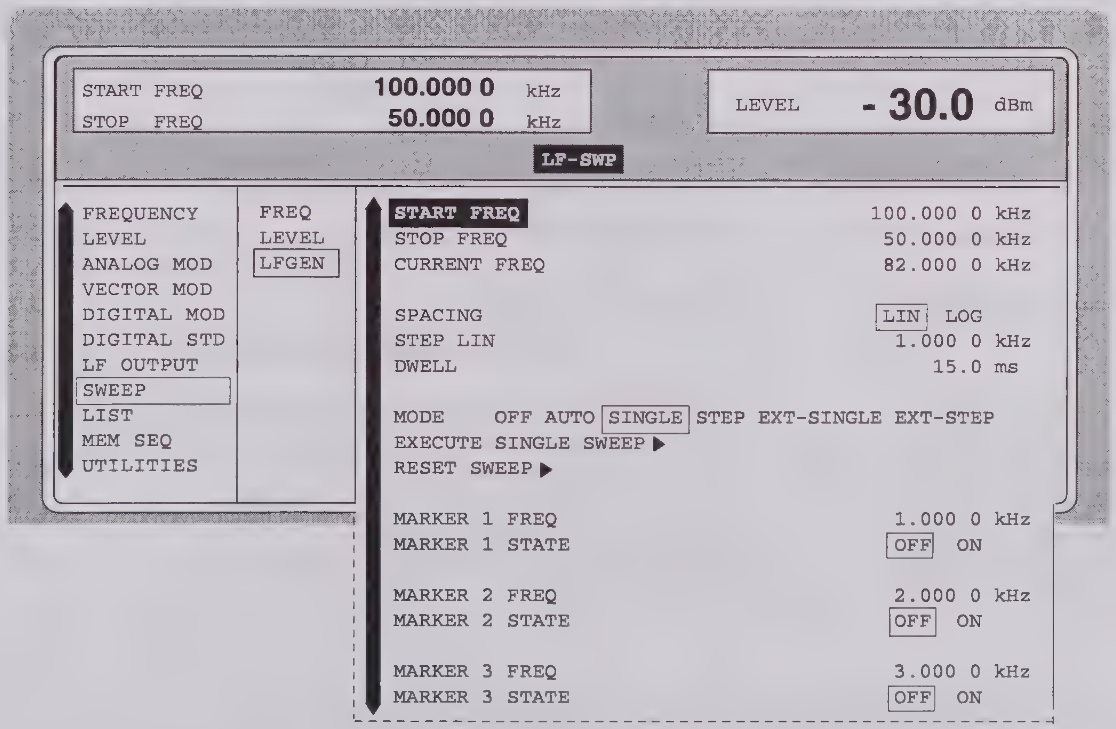
Switching on/off the marker selected.

IEC/IEEE-bus command `:SOUR:MARK1:PSW OFF`

2.22.8 LF-Sweep

Menu SWEEP - LF GEN offers access to settings for LF sweep.

Menu selection: SWEEP - LF GEN



```
START FREQ     100.000 0  kHz          LEVEL   - 30.0  dBm
STOP  FREQ      50.000 0  kHz
                         LF-SWP

FREQUENCY     FREQ    START FREQ                              100.000 0 kHz
LEVEL         LEVEL   STOP FREQ                                50.000 0 kHz
ANALOG MOD    LFGEN   CURRENT FREQ                             82.000 0 kHz
VECTOR MOD
DIGITAL MOD           SPACING                                 LIN  LOG
DIGITAL STD           STEP LIN                                  1.000 0 kHz
LF OUTPUT             DWELL                                      15.0 ms
SWEEP
LIST                  MODE    OFF AUTO SINGLE STEP EXT-SINGLE EXT-STEP
MEM SEQ               EXECUTE SINGLE SWEEP ▶
UTILITIES             RESET SWEEP ▶

                      MARKER 1 FREQ                             1.000 0 kHz
                      MARKER 1 STATE                          OFF  ON

                      MARKER 2 FREQ                             2.000 0 kHz
                      MARKER 2 STATE                          OFF  ON

                      MARKER 3 FREQ                             3.000 0 kHz
                      MARKER 3 STATE                          OFF  ON
```

Fig. 2-192 Menu SWEEP - LF GEN

START FREQ	Input value of the starting frequency. IEC/IEEE-bus command `:SOUR2:FREQ:STAR 100kHz`
STOP FREQ	Input value of the stop frequency. IEC/IEEE-bus command `:SOUR2:FREQ:STOP 50kHz`
CURRENT FREQ	Indication of the current frequency value. Operating mode STEP: Input value of the frequency.
STEP	Input value of the step width. IEC/IEEE-bus command `:SOUR2:SWE:STEP:LIN 1kHz`
DWELL	Input value of the dwell time per step. IEC/IEEE-bus command `:SOUR2:SWE:DWEL 15ms`
SPACING	Selection of the sweep run, linear or logarithmic. IEC/IEEE-bus command `:SOUR2:SWE:SPAC LIN`

MODE	Selection of the sweep operating mode.
	IEC/IEEE-bus command `:SOUR2:FREQ:MODE SWE`
	`:SOUR2:SWE:MODE AUTO`
	`:TRIG2:SOUR SING`

EXECUTE SINGLE SWEEP ▶	Starts a single sweep run. This action to be executed is only indicated and is only effective if MODE SINGLE is selected. IEC/IEEE-bus command `:TRIG`
RESET SWEEP ▶	Sets the starting frequency. IEC/IEEE-bus command `:ABOR`
MARKER 1 FREQ **MARKER 2 FREQ** **MARKER 3 FREQ**	Input value of the frequency for the marker selected. IEC/IEEE-bus command `:SOUR2:MARK1:FREQ 1kHz`
MARKER 1 STATE **MARKER 2 STATE** **MARKER 3 STATE**	Switching on/off the marker selected. IEC/IEEE-bus command `:SOUR2:MARK1 OFF`

2.23 LIST Mode

A sequence of predefined frequency and level points is executed in the LIST mode, similar as in a sweep. Differently from the sweep, however, a list with freely selectable pairs of values (frequency and level) can be generated. The specified range of the frequency comprises the entire adjustable frequency range of the instrument. The specified range of the level covers a 20-dB range. If the permissible variation range is exceeded, the level error increases.

Caution: *After the generation or change of a list in the LIST mode, function LEARN has to be started to ensure that the new settings are transferred to the hardware (IEC-bus short command:* `LIST:LEAR`*.*

Table 2-36 LIST mode; Example of a list

Index	**Frequency**	**Level**
0001	100 MHz	0 dBm
0002	575 MHz	13 dBm
0003	235 MHz	7 dBm
0100	333 MHz	5 dBm
:	:	:

Up to 10 lists can be created. The total amount of possible pairs of values including all lists may maximally be 2000. I.e., a list may have 2000 entries at the most, or less if several lists have been created.

Each list is identified by a separate name and selected via this name. A detailed description how to process the lists can be found in Section 2.2.11, List Editor.

2.23.1 Operating Modes (MODE)

The following LIST-operating modes are available:

AUTO Run from the beginning to the end of the list with automatic restart at the beginning. If another mode was activated prior to the AUTO operating mode, continuation is made from the current index.

IEC/IEEE-bus commands:

```
:SOUR:FREQ:MODE LIST
:SOUR:LIST:MODE AUTO
:TRIG:LIST:SOUR AUTO
```

SINGLE Single run from the beginning to the end of the list. If SINGLE is selected, the run is not yet started. Function EXECUTE SINGLE LIST ▶ to be executed, which can be used to start the run, is displayed below the MODE line.

IEC/IEEE-bus commands:

```
:SOUR:FREQ:MODE LIST
:SOUR:LIST:MODE AUTO
:TRIG:LIST:SOUR SING
```

STEP Step-by-step manual processing of the list. Activating STEP stops a list running and the cursor wraps to the indication value of CURRENT INDEX. The list can now be controlled upwards or downwards in discrete steps using the rotary knob or the numeric keys.

IEC/IEEE-bus commands:

```
:SOUR:FREQ:MODE LIST
:SOUR:LIST:MODE STEP
:TRIG:LIST:SOUR SING
```

EXT-SINGLE Single run from the beginning to the end of the list as with SINGLE, but triggered by an external trigger signal.

IEC/IEEE-bus commands:

```
:SOUR:FREQ:MODE LIST;
:SOUR:LIST:MODE AUTO
:TRIG:LIST:SOUR EXT
```

EXT-STEP Step-by-step run by means of the external trigger signal. Each trigger event triggers a single step.

IEC/IEEE-bus commands:

```
:SOUR:FREQ:MODE LIST
:SOUR:LIST:MODE STEP
:TRIG:LIST:SOUR EXT
```

HOP Step-by-step run by means of the internal trigger signal of the data generator (see also Section 'Internal Modulation Data and Control Signals from Lists' and Section 'Menu DIGITAL STANDARD - GSM'). Each trigger event triggers a single step.

IEC/IEEE-bus commands:

```
:SOUR:FREQ:MODE LIST
:SOUR:LIST:MODE STEP
:TRIG:LIST:SOUR HOP
```

OFF Operating mode LIST is switched off.

IEC/IEEE-bus command: `:SOUR:FREQ:MODE CW`

Note: *The minimum step time of 1 ms must not be violated in modes EXT-STEP and HOP either. With fading switched on, the mimimum step time is increased to 3 ms, in case of LogNormal fading it is increased to 50 ms.*

2.23.2 Inputs/Outputs

TRIGGER input and BLANK output are available at the rear of the instrument for synchronization with other instruments.

TRIGGER An external signal at this input triggers the LIST mode in operating modes EXT-SINGLE and EXT-STEP. The polarity of the active trigger edge can be set in the UTILITIES - AUX I/O - EXT TRIG SLOPE menu.

BLANK This output supplies a signal (0 V/5 V) to blank the settling process by means of pulse modulation or AM. The signal can also be used to synchronize other instruments. The polarity of the signal can be set in the UTILITIES - AUX I/O - BLANK POLARITY menu.

MARKER At the first step of the LIST mode, this output provides an approx. 200 µs trigger signal immediately after blanking. At small DWELL times, this signal can be used for an accurate synchronization to trigger other devices and shows the first stable output frequency. The delay to the fed-in signal at the TRIGGER input for EXT-SINGLE or EXT-STEP is 1.5 to 2 ms and has a jitter of 0.5 ms.

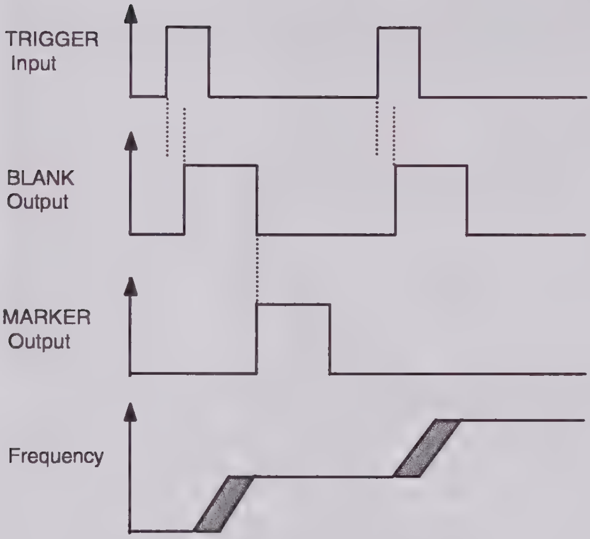
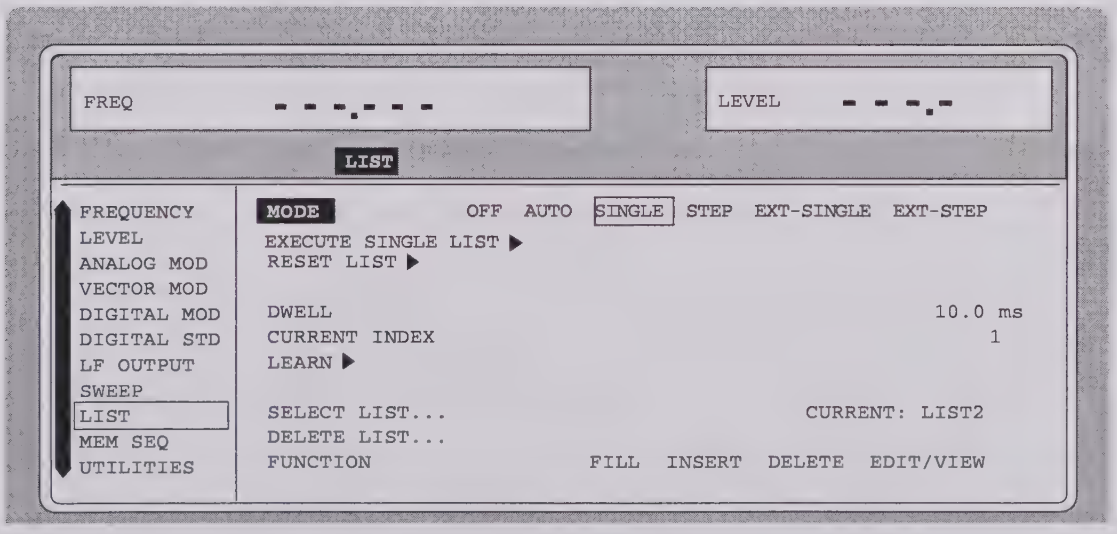


Fig. 2-193 Signal example LIST mode: MODE = EXT-STEP

The LIST menu offers access to settings for the LIST mode.

Menu selection: LIST



MODE OFF AUTO [✓ SINGLE] STEP EXT-SINGLE EXT-STEP
EXECUTE SINGLE LIST ▶
RESET LIST ▶

DWELL 10.0 ms
CURRENT INDEX 1
LEARN ▶

SELECT LIST... CURRENT: LIST2
DELETE LIST...
FUNCTION FILL INSERT DELETE EDIT/VIEW

Fig. 2-194 Menu LIST - OPERATION page

MODE

Selection of the operating mode.

IEC/IEEE-bus commands :

```
:SOUR:FREQ:MODE LIST;
:SOUR:LIST:MODE AUTO;
:TRIG:LIST:SOUR SING
```

EXECUTE SINGLE LIST ▶

Starts a single run of a list. This menu option is only visible if MODE SINGLE is selected.

IEC/IEEE-bus command : `:TRIG:LIST`

RESET LIST ▶

Sets the starting point.

IEC/IEEE-bus command `:ABOR:LIST`

DWELL

Input value of the dwell time per step.

IEC/IEEE-bus command `:SOUR:LIST:DWEL 10ms`

CURRENT INDEX

Indication of the current list index. Setting value of the current list index in the STEP operating mode.

LEARN ▶

Starts the LEARN function. All value pairs of the active list are subsequently set by the instrument with the current additional parameters, and the hardware setting data are stored.

Caution: *This function must be called after every creating and altering the list (or the remaining setting data). The list must be learned as well after temperature changes or after calling internal calibration routines, as all parameters usually controlled are replaced by stored values in the LIST mode.*

IEC/IEEE-bus command `:SOUR:LIST:LEAR`

SELECT LIST...

Selection of a list or creation of a new list (cf. Section 2.2.11, List Editor).

IEC/IEEE-bus command `:SOUR:LIST:SEL 'LIST2'`

DELETE LIST...

Deletion of a list (cf. Section 2.2.11, List Editor).

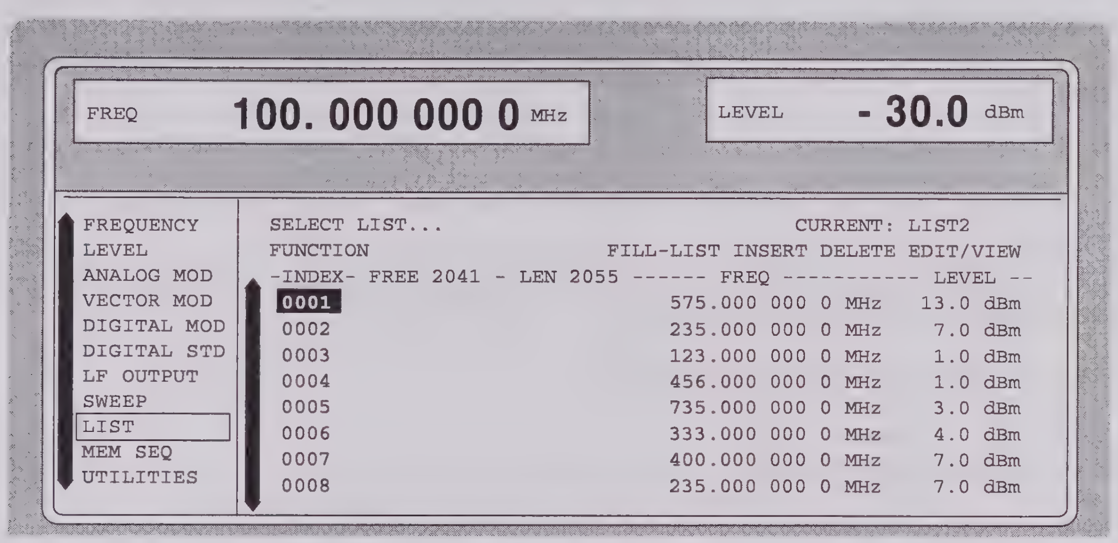
IEC/IEEE-bus command `:SOUR:LIST:DEL  'LIST1'`

FUNCTION

Selection of the editor functions to process a list (cf. Section 2.2.11, List Editor).

IEC/IEEE `:SOUR:LIST:FREQ 100MHz, 1.2GHz; POW 0dBm, 6dBm`

The second page of the LIST menu, the EDIT page is automatically activated if one of the editor functions of line FUNCTION is selected. The list which is displayed as CURRENT LIST in the SELECT LIST line is shown.



```
FREQ     100. 000 000 0 MHz                LEVEL     - 30.0 dBm

SELECT LIST...                              CURRENT: LIST2
FUNCTION                    FILL-LIST INSERT DELETE EDIT/VIEW
-INDEX- FREE 2041 - LEN 2055 ------ FREQ ----------- LEVEL --
 0001                       575.000 000 0 MHz   13.0 dBm
 0002                       235.000 000 0 MHz    7.0 dBm
 0003                       123.000 000 0 MHz    1.0 dBm
 0004                       456.000 000 0 MHz    1.0 dBm
 0005                       735.000 000 0 MHz    3.0 dBm
 0006                       333.000 000 0 MHz    4.0 dBm
 0007                       400.000 000 0 MHz    7.0 dBm
 0008                       235.000 000 0 MHz    7.0 dBm
```

Fig. 2-195 Menu List - EDIT page

INDEX	Index of the list.
FREE	Indication of the list entries still vacant.
LENGTH	Length of the current list.
FREQ	Parameter: Frequency.
LEVEL	Parameter: Level; specified range 20 dB.

2.24 Memory Sequence

In the memory-sequence operating mode the instrument automatically services a list with stored instrument settings. Memory locations 1 to 50, which are loaded using SAVE and whose stored settings are called either separately using RECALL or automatically and subsequently in the SEQUENCE mode, are available.

The list is continuously serviced from the beginning to the end with a continual index. The order of the memories to be passed through is arbitrary. Each setting can be assigned a freely selectable dwell time. The dwell time determines the duration of the setting, its minimal value is 50 ms, its maximal value 60 sec.

The list is divided up into 3 columns for list index, memory location number (Memory) and dwell time (Dwell). The beginning of the list has index 1.

Table 2-37 MEMORY SEQUENCE; Example of a list

Index	**Memory**	**Dwell**
001	09	50.0 ms
002	02	50.0 ms
003	01	75.0 ms
004	10	75.0 ms
...	...	...

Up to 10 sequence lists can be created. The total number of possible list elements is maximally 256. I.e., a list can have 256 entries at the most, or less if several lists have been created.

Each list is identified by a separate name and selected via this name. A detailed description how to process the lists can be found in Section 2.2.4, List Editor.

Note: *Frequently changing the level in the operating mode MEMORY SEQUENCE can stress the mechanically switched attenuator. The attenuator is also actuated when AM is switched on or off. For this reason we recommend that you make use of the non-interrupting level setting as much as possible and that you use the setting AM 0% instead of switching AM off.*

Operating Modes (MODE)

The following operating modes are available:

AUTO

Run from the beginning to the end of the list with automatic restart at the beginning. If another mode was activated prior to the AUTO operating mode, continuation is made from the current index.

IEC/IEEE-bus command:

```
:SYST:MODE MSEQ;
:SYST:MSEQ:MODE AUTO
:TRIG:MSEQ:SOUR AUTO
```

SINGLE

Single run from the beginning to the end of the list. If SINGLE is selected, the run is not yet started. Below the MODE line, function EXECUTE SINGLE SEQUENCE ▶ to be executed is displayed which can be used to start the run.

IEC/IEEE-bus command

```
:SYST:MODE MSEQ;
:SYST:MSEQ:MODE AUTO
:TRIG:MSEQ:SOUR SING
```

STEP

Step-by-step manual processing of the list. Activating STEP stops an automatic run and the cursor wraps to the indication value of CURRENT INDEX. The list can now be passed through upwards or downwards step by step using the rotary knob.

IEC/IEEE-bus command

```
:SYST:MODE MSEQ;
:SYST:MSEQ:MODE STEP
:TRIG:MSEQ:SOUR SING
```

EXT-SINGLE

Single run from the beginning to the end of the list as with SINGLE, but triggered by an external trigger signal.

IEC/IEEE-bus command

```
:SYST:MODE MSEQ;
:SYST:MSEQ:MODE AUTO
:TRIG:MSEQ:SOUR EXT
```

EXT-STEP

Step-by-step run using the external trigger signal. Each trigger event triggers a single step.

IEC/IEEE-bus command

```
:SYST:MODE MSEQ;
:SYST:MSEQ:MODE STEP
:TRIG:MSEQ:SOUR EXT
```

OFF

Step-by-step run using the external trigger signal. Each trigger event triggers a single step.

IEC/IEEE-bus command

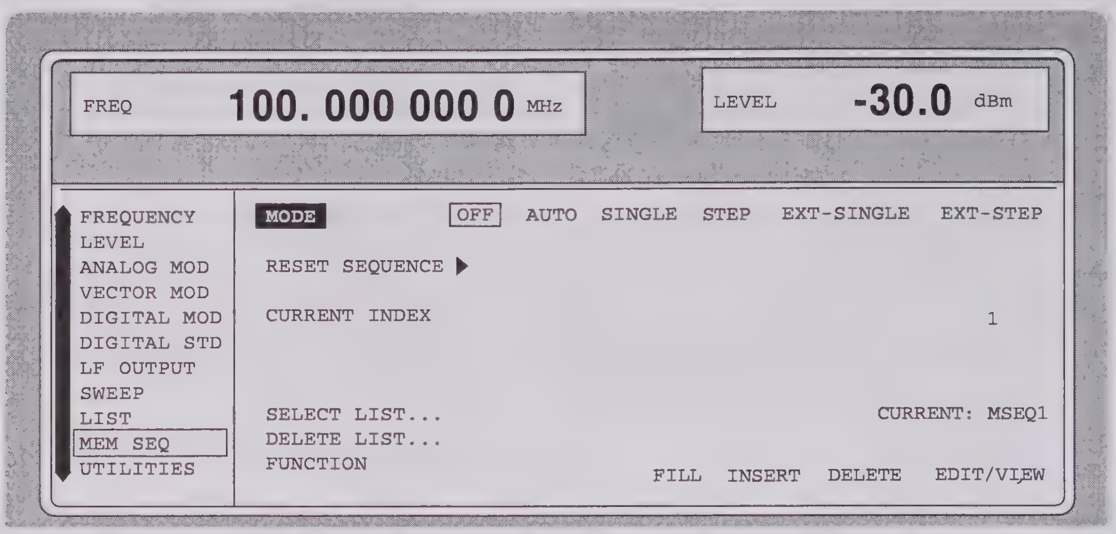
```
:SYST:MODE FIX
```

External Trigger

An external signal at the rear input TRIGGER triggers the MEMORY SEQUENCE in the EXT-SINGLE and EXT-STEP operating modes. The polarity of the active trigger edge can be set in the UTILITIES - AUX I/O - EXT TRIG SLOPE menu.

Menu MEM SEQ with the two menu pages OPERATION and EDIT offers access to the memory-sequence operating mode.

Menu selection: MEM SEQ



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

MODE OFF

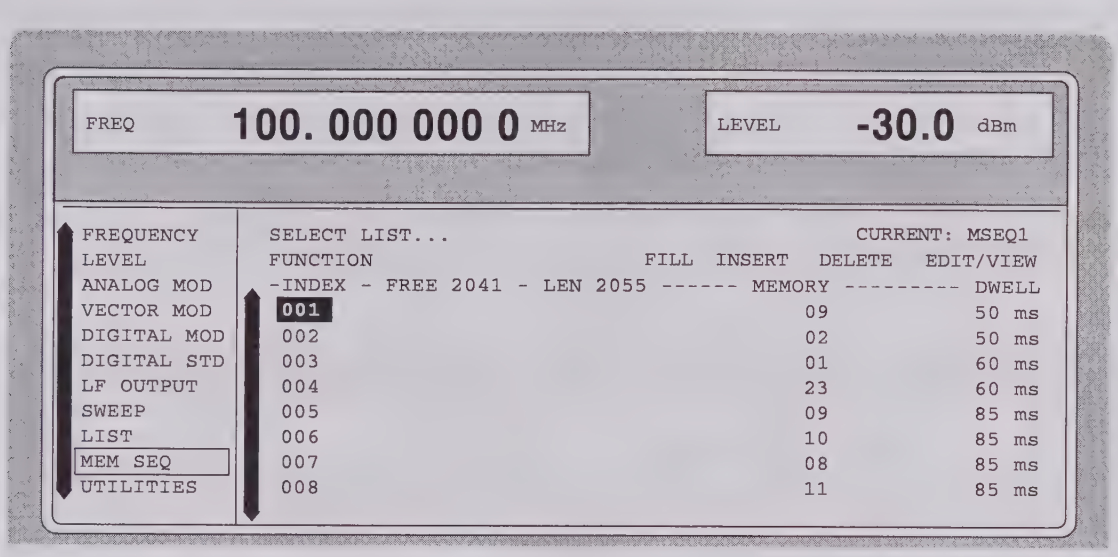
CURRENT INDEX 1

CURRENT: MSEQ1

Fig. 2-196 Menu MEM SEQ -OPERATION-page (preset setting)

MODE	Selection of the operating mode; setting the operating mode regards various command systems at the IEC bus (cf. above).
EXECUTE SINGLE SEQUENCE ▶	Starts the single run of a memory sequence. This menu option is only visible if MODE SINGLE is selected. IEC/IEEE-bus command `:TRIG:MSEQ`
RESET SEQUENCE ▶	Wrap to the beginning of the list. IEC/IEEE-bus command `:ABOR:MSEQ`
CURRENT INDEX	Indication of the current list index. Setting value of the current list index in the MODE STEP operating mode.
SELECT LIST...	Selection of a list or generation of a new list (cf. Section 2.2.4, List Editor). IEC/IEEE-bus command `:SYST:MSEQ:SEL "MSEQ1"`
DELETE LIST...	Deletion of a list (cf. Section 2.2.4, List Editor). IEC/IEEE-bus command `:SYST:MSEQ:DEL "MSEQ2"`
FUNCTION	Selection of the editor functions to process a list (cf. Section 2.2.4, List Editor). IEC/IEEE-bus command `:SYST:MSEQ 9,2,...;` `:SYST:MSEQ:DWEL 50ms, 50ms,.`

The second page of menu MEM SEQ, the EDIT page, is automatically activated if one of the editor functions of the FUNCTION line is selected. The list which is entered as CURRENT LIST in the SELECT LIST line is shown.



```
FREQ      100. 000 000 0 MHz          LEVEL     -30.0 dBm

SELECT LIST...                                   CURRENT: MSEQ1
FUNCTION                      FILL  INSERT  DELETE  EDIT/VIEW
-INDEX - FREE 2041 - LEN 2055 ------ MEMORY --------- DWELL
 001                                   09              50 ms
 002                                   02              50 ms
 003                                   01              60 ms
 004                                   23              60 ms
 005                                   09              85 ms
 006                                   10              85 ms
 007                                   08              85 ms
 008                                   11              85 ms
```

Fig. 2-197 Menu MEM SEQ - EDIT page

INDEX	Index of the list.
FREE	Indication of the list entries still vacant.
LEN	Length of the current list.
MEMORY	Parameter: number of memory location; range 1 to 50.
DWELL	Parameter: dwell time; specified range 50 ms to 60 sec, step width 1 ms.

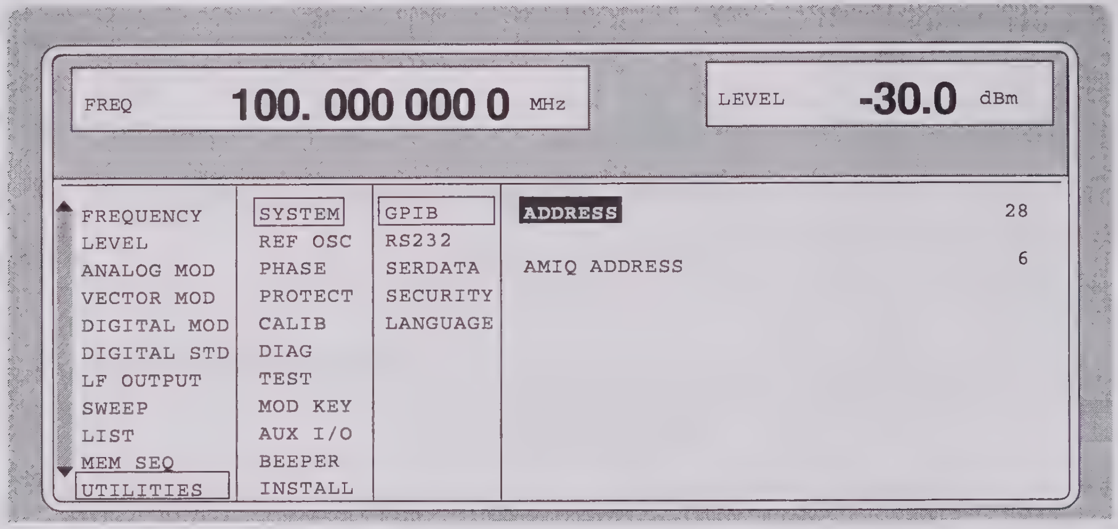
2.25 Utilities

The UTILITIES menu contains submenus for general functions which do not directly relate to the signal generation.

2.25.1 IEC-Bus Address (SYSTEM-GPIB)

Submenu SYSTEM-GPIB offers access to the remote-control address. The setting range is 0 to 30. At the point of delivery address 28 is set.

Menu selection: UTILITIES -SYSTEM -GPIB



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

ADDRESS 28

AMIQ ADDRESS 6

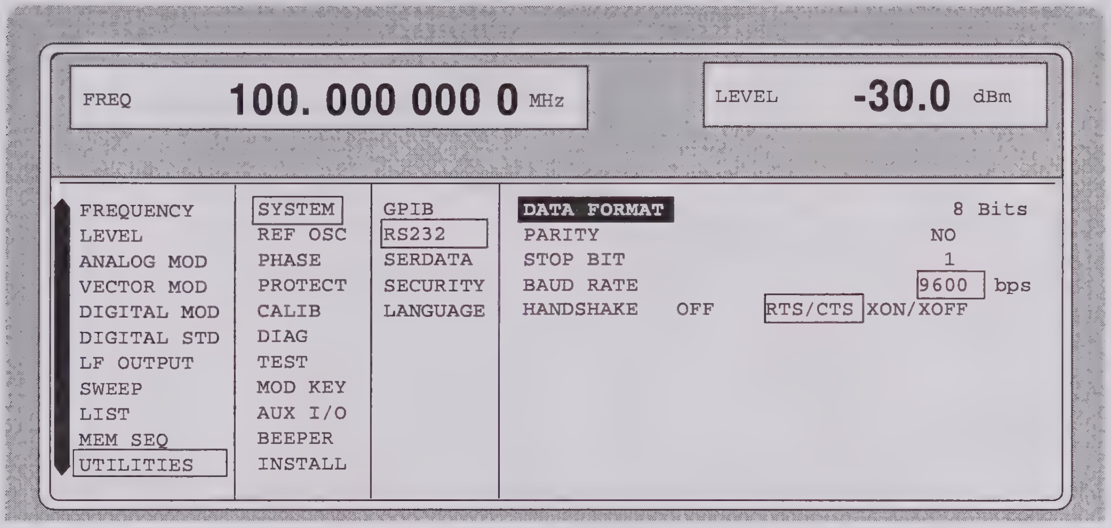
Fig. 2-198 Menu UTILITIES -SYSTEM -GPIB

ADDRESS	Input value of the IEC-bus address IEC/IEEE-bus command `:SYST:COMM:GPIB:ADDR 28`
AMIQ ADDRESS	IEC/IEEE-bus address of AMIQ.

2.25.2 Parameter of the RS232 Interface (SYSTEM-RS232)

Submenu SYSTEM-RS232 offers access to the configuration of the RS-232 interface. The pin assignment of the interface corresponds to the pin assignment of a PC.

Menu selection: UTILITIES - SYSTEM - RS232


FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

DATA FORMAT 8 Bits

PARITY NO

STOP BIT 1

BAUD RATE 9600 bps

HANDSHAKE OFF RTS/CTS XON/XOFF

Fig. 2-199 Menu UTILITIES - SYSTEM - RS232

DATA FORMAT Indication of the number of data bits. This value cannot be changed.

PARITY Indication of parity. This value cannot be changed.

STOP BIT Indication of the number of stop bits. This value cannot be changed.

BAUD RATE Selection of the baud rate.

IEC/IEEE-bus command `:SYST:COMM:SER:BAUD 9600`

HANDSHAKE Selection of the handshake.

OFF No handshake

IEC/IEEE-bus command `:SYST:COMM:SER:PACE NONE`
`:SYST:COMM:SER:CONT:RTS ON`

RTS/CTS Hardware handshake using the interface lines RTS and CTS. This mode always is to be preferred to XON/XOFF mode, if permitted by the configuration of the host computer.

IEC/IEEE-bus command `:SYST:COMM:SER:CONT:RTS RFR`

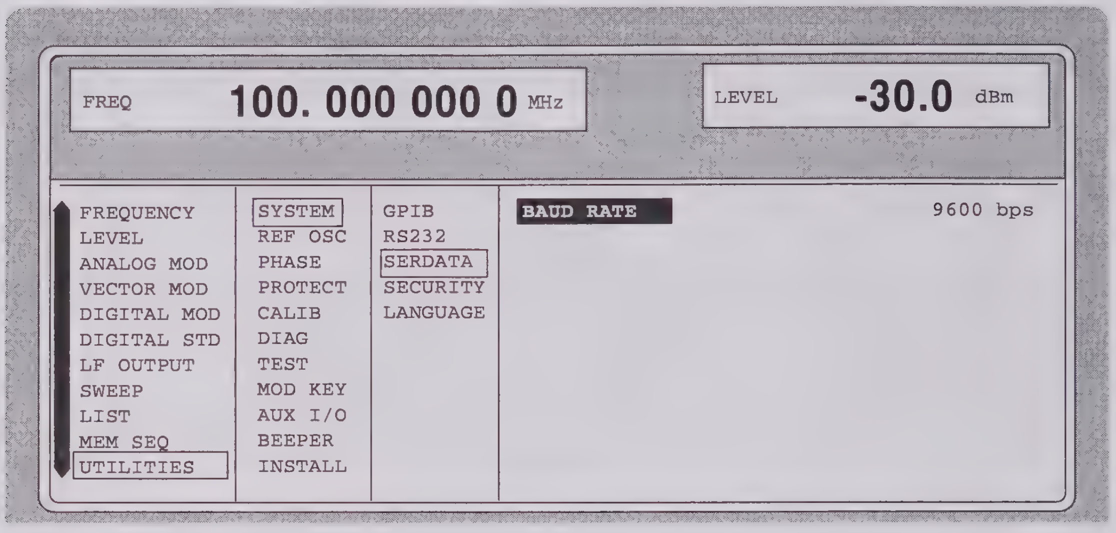
XON/XOFF Software handshake using the ASCII codes 11h <XON> and 13h <XOFF>. This mode is not recommended for binary data and for baud rates above 9600 baud.

IEC/IEEE-bus command `:SYST:COMM:SER:PACE XON`

2.25.3 Parameter of the SER DATA Input (SYSTEM-SERDATA)

Submenu SYSTEM-SERDATA offers access to the configuration of the SERDATA input.

Menu selection: UTILITIES - SYSTEM - SERDATA



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

BAUD RATE 9600 bps

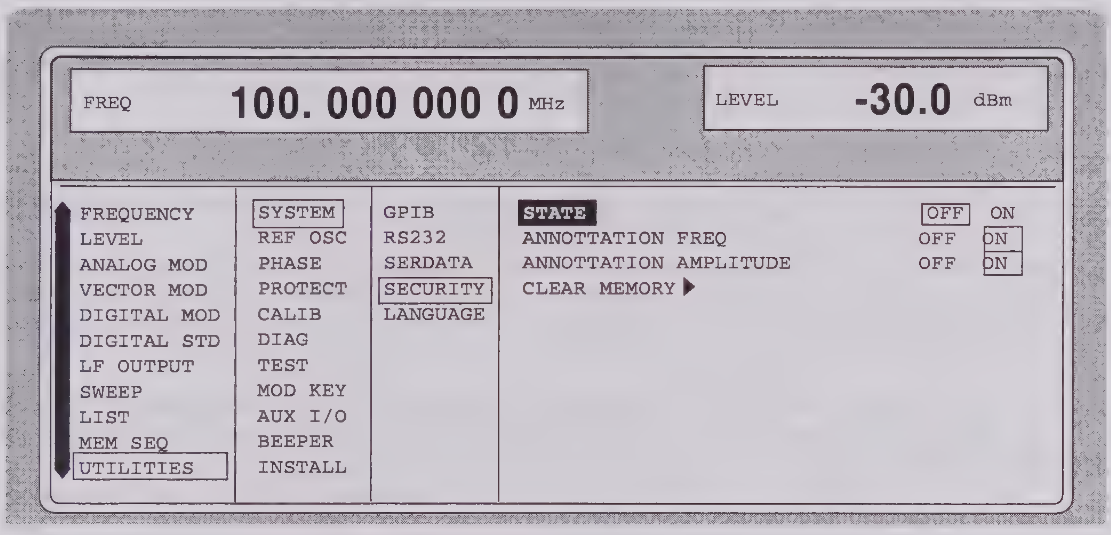
Fig. 2-200 Menu UTILITIES - SYSTEM - SERDATA

BAUD RATE Selection of the baud rate.
IEC/IEEE-bus command `:SYST:COMM:SDAT:BAUD 9600`

2.25.4 Suppressing Indications and Deleting Memories (SYSTEM-SECURITY)

For security interests, indications can be suppressed and memories deleted in the SYSTEM-SECURITY submenu.

Menu selection: UTILITIES - SYSTEM-SECURITY



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

STATE OFF ON
ANNOTTATION FREQ OFF ON
ANNOTTATION AMPLITUDE OFF ON

Fig. 2-201 Menu UTILITIES - SYSTEM-SECURITY

STATE

Selection of the SECURITY state

ON — Locks the suppression of the indications. Can only be set via IEC bus.

OFF — Deactivates the interlock of the indication suppression. The preset state is set in the transition ON→OFF, and all data stored such as settings, with the exception of the DM lists are deleted. Can only be set via IEC bus.

IEC/IEEE-bus command `:SYST:SEC OFF`

ANNOTATION FREQ

OFF — All frequency indications are suppressed.

ON — The frequency setting is displayed..

IEC/IEEE-bus command `:DISP:ANN:FREQ ON`

ANNOTATION AMPLITUDE

OFF — All level indications are suppressed.

ON — The level setting is displayed.

IEC/IEEE-bus command `:DISP:ANN:AMPL ON`

CLEAR MEMORY ▶

Deletion of all data stored such as settings, user correction and list settings stored, with the exception of the DM lists.

For this action, two commands are necessary at the IEC bus:

IEC/IEEE-bus command `:SYST:SEC ON; SEC OFF`

2.25.5 Indication of the IEC-Bus Language (LANGUAGE)

Submenu UTILITIES-SYSTEM LANGUAGE indicates the IEC-bus language and the current SCPI version.

2.25.6 Reference Frequency Internal/External (REF OSC)

In the internal-reference operating mode, the internal reference signal at a frequency of 10 MHz is available at the REF socket (rear of the instrument).

Signal level: V_{eff} (EMF, sine) = 1 V.

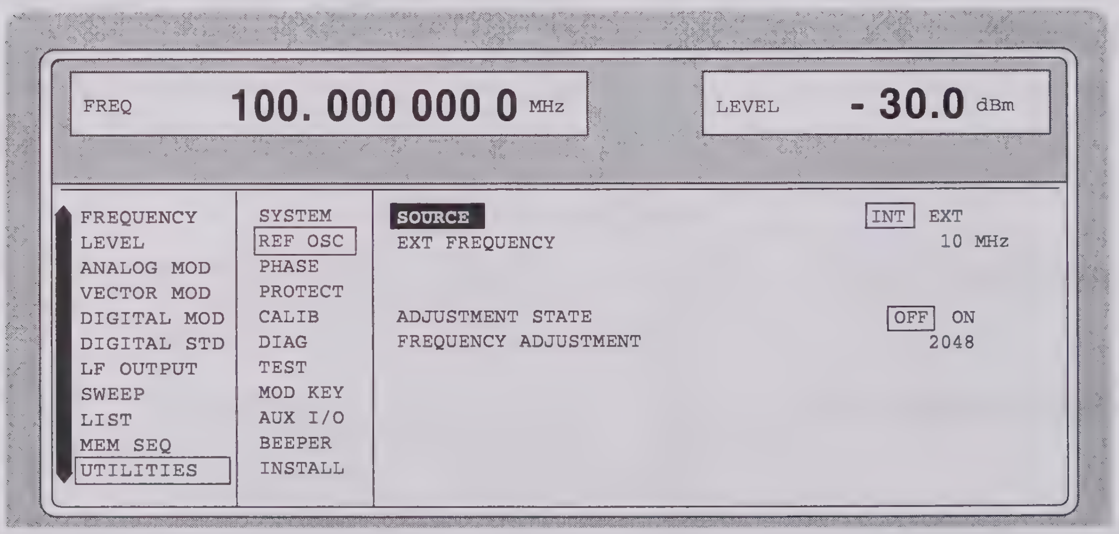
The frequency of the internal reference oscillator can be detuned via the EXT TUNE input (rear of the instrument). Input voltage range ±10 V, pulling range $\pm1\times10^{-6}$.
The external detuning is possible in both states of the ADJUSTMENT STATE (ON or OFF) unless option SM-B1, reference oscillator OCXO, is fitted. If option SM-B1, reference oscillator OCXO, is fitted, the detuning via the TUNE input is only possible if the ADJUSTMENT STATE selection has been switched to ON in the UTILITIES-REF OSC menu.

In the external-reference operating mode, an external signal at a frequency of 1 MHz to 16 MHz (spacing 1 MHz) is to be fed into socket REF. The setting to external frequency is effected in the UTILITIES-REF OSC menu.

Signal level: V_{eff} = 0.1 to 2 V

The message "EXT REF" is displayed in the status line in the header field of the display in the external-reference operating mode.

Menu selection: UTILITIES - REF OSC



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

SOURCE [INT] EXT

EXT FREQUENCY 10 MHz

ADJUSTMENT STATE [OFF] ON

FREQUENCY ADJUSTMENT 2048

Fig. 2-202 Menu UTILITIES - REF OSC (preset setting)

SOURCE

Selection of the operating mode.

INT	Internal-reference operating mode
EXT	External-reference operating mode

IEC/IEEE-bus command `SOUR:ROSC:SOUR INT`

EXT FREQUENCY

Input value of the external reference frequency (1 MHz to 16 MHz, spacing 1 MHz).

IEC/IEEE-bus command `SOUR:ROSC:EXT:FREQ 10E6`

ADJUSTMENT STATE

OFF Tuning value of the internal reference frequency as calibrated (cf. menu UTILITIES-CALIB)

ON Tuning value according to setting value FREQUENCY ADJUSTMENT. Option SM-B1, reference oscillator OCXO, is switched off. Only the standard reference oscillator is in operation.

IEC/IEEE-bus command `SOUR:ROSC:ADJ:STAT ON`

FREQUENCY ADJUSTMENT

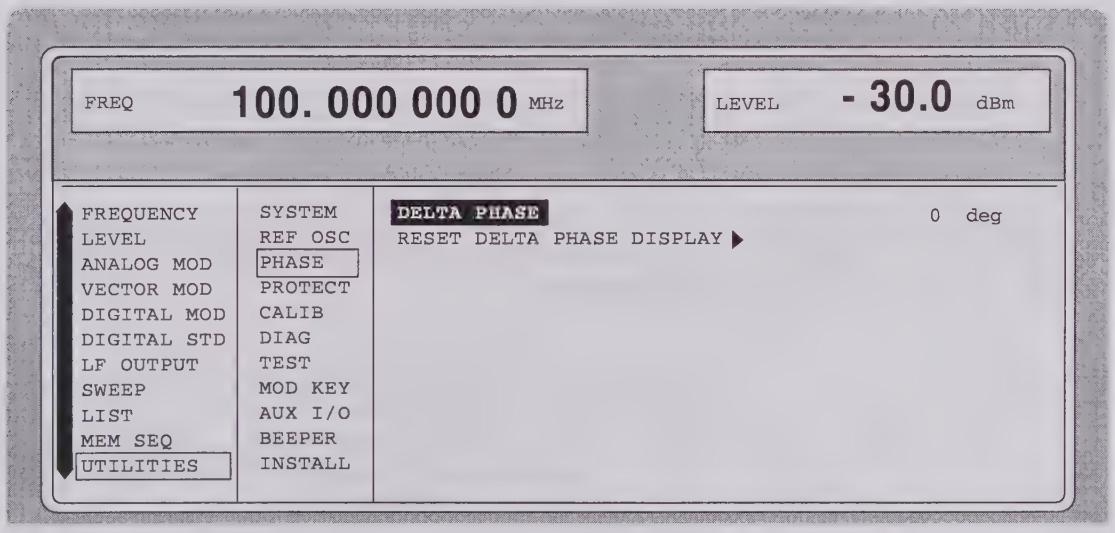
Input value in the range 0 to 4095 to set the internal reference frequency. Pulling range ±4×10^{-6}

IEC/IEEE-bus command `SOUR:ROSC:ADJ:VAL 2048`

2.25.7 Phase of the Output Signal (PHASE)

Menu UTILITIES-PHASE offers access to the phase setting of the RF output signal with respect to a reference signal of the same frequency.

Menu selection: UTILITIES - PHASE


FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

DELTA PHASE 0 deg

RESET DELTA PHASE DISPLAY ▶

Fig. 2-203 Menu UTILITIES - PHASE (preset setting)

DELTA PHASE

Setting value of the phase.

IEC/IEEE-bus command `:SOUR:PHAS 10 DEG`

RESET DELTA PHASE DISPLAY ▶

Sets the display of the DELTA PHASE to 0 without the phase of the output signal being influenced.

IEC/IEEE-bus command `:SOUR:PHAS:REF`

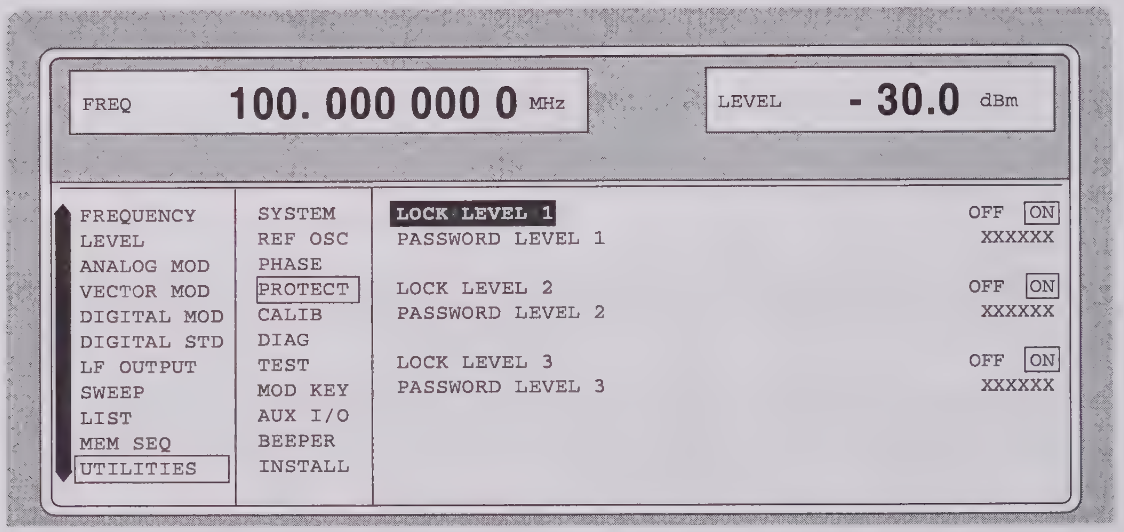
2.25.8 Password Input With Functions Protected (PROTECT)

The execution of calibrating and service functions is protected by a password. To unlock the lock-out, the correct password, a 6-digit number, has to be entered and then the [ENTER] key has to be pushed. After the instrument has been switched on, the lock-out is automatically activated.

Password 1	unlocks the lock-out for calibrations LEV PRESET and VCO SUM.
Password 2	unlocks the lock-out for calibration REF OSC.
Password 3	permits the input of the serial number and the value of the counter for POWER ON, operating hours and attenuator circuits.

Menu UTILITIES-PROTECT offers access to the unlocking of protected functions.

Menu selection: UTILITIES - PROTECT



```
FREQ    100. 000 000 0 MHz        LEVEL   - 30.0 dBm

LOCK LEVEL 1                      OFF  ON
PASSWORD LEVEL 1                  XXXXXX

LOCK LEVEL 2                      OFF  ON
PASSWORD LEVEL 2                  XXXXXX

LOCK LEVEL 3                      OFF  ON
PASSWORD LEVEL 3                  XXXXXX
```

Fig. 2-204 Menu UTILITIES - PROTECT (preset setting)

LOCK LEVEL x Activating/deactivating the lock-out.

ON The lock-out is activated.

OFF The cursor automatically wraps to the input of the password. After the password has been entered, the lock-out is deactivated.

IEC/IEEE-bus command `:SYST:PROT1 ON`

PASSWORD LEVEL x Input of the password; termination with [ENTER] key.

IEC/IEEE-bus command `:SYST:PROT1 OFF, 123456`

2.25.9 Calibration (CALIB)

For servicing, the following menus offer access to calibrating routines and correction values:
UTILITIES - CALIB - ALL
VCO SUM
VECTOR MOD
LEV PRESET
REF OSC (cf. service manual)
LEVEL (cf. service manual)
ALC TABLE
LEV ATT

Internal calibration routines LEV PRESET and VCO SUM are protected by a password. They can only be executed if the lock-out in the UTILITIES - PROTECT menu has been unlocked. The password is PASSWORD LEVEL 1 = "123456".

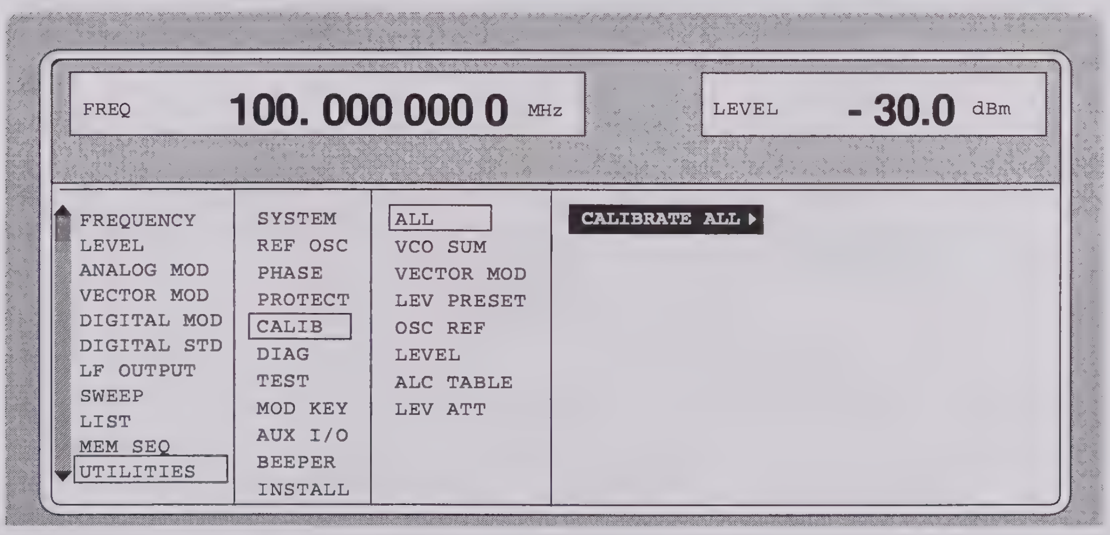
Caution: *Execute calibration routines only when the instrument has warmed up*

Calibration routines LEVEL and REF OSC are described in the service manual.

Calibration ALL

CALIB ALL triggers all internal calibrations which do not require any external measuring equipment. The calibrations with external measurements are described in the service manual.

Menu selection: UTILITIES - CALIB - ALL



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

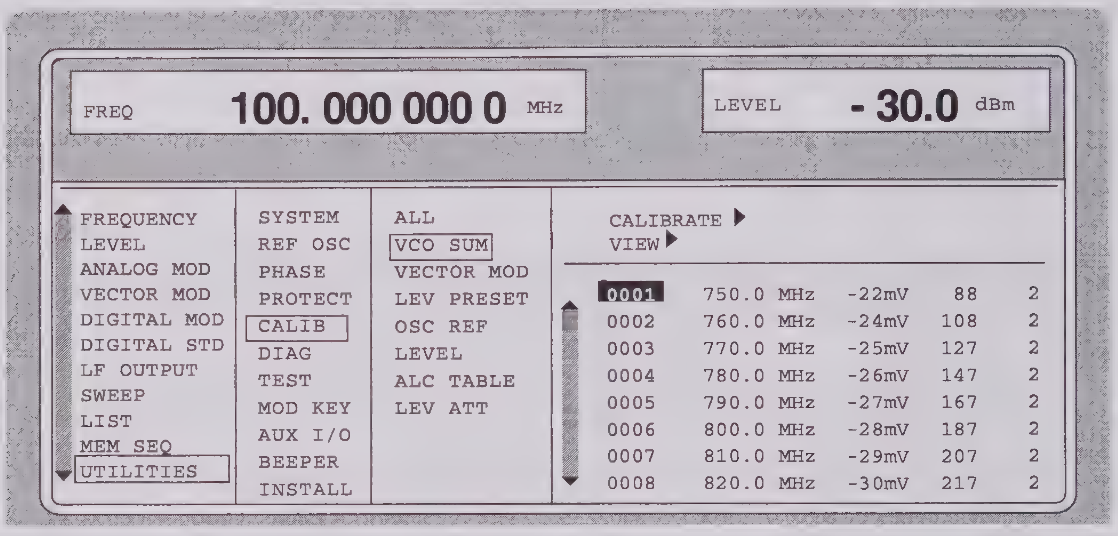
Fig. 2-205 Menu UTILITIES - CALIB - ALL

CALIBRATE ALL ▶ Triggers all internal calibrations.
IEC\IEEE-bus command `:CAL:ALL?`

Calibration VCO SUM

To synchronize the summing loop, the frequency the oscillator generates must be so close to the rated frequency that the phase control can lock in. This is effected by means of presetting values. The presetting values are stored in a table and can be renewed using internal calibration routine VCO SUM. The calibration routine needs only be executed after a data loss in the RAM or after an exchange of modules.

Menu selection: UTILITIES - CALIB - VCO SUM



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

```
0001   750.0 MHz   -22mV    88    2
0002   760.0 MHz   -24mV   108    2
0003   770.0 MHz   -25mV   127    2
0004   780.0 MHz   -26mV   147    2
0005   790.0 MHz   -27mV   167    2
0006   800.0 MHz   -28mV   187    2
0007   810.0 MHz   -29mV   207    2
0008   820.0 MHz   -30mV   217    2
```

Fig. 2-206 Menu UTILITIES - CALIB - VCO SUM

CALIBRATE ▶ Triggers the calibration for the VCO summing loop.

IEC/IEEE-bus command `:CAL:VSUM?`

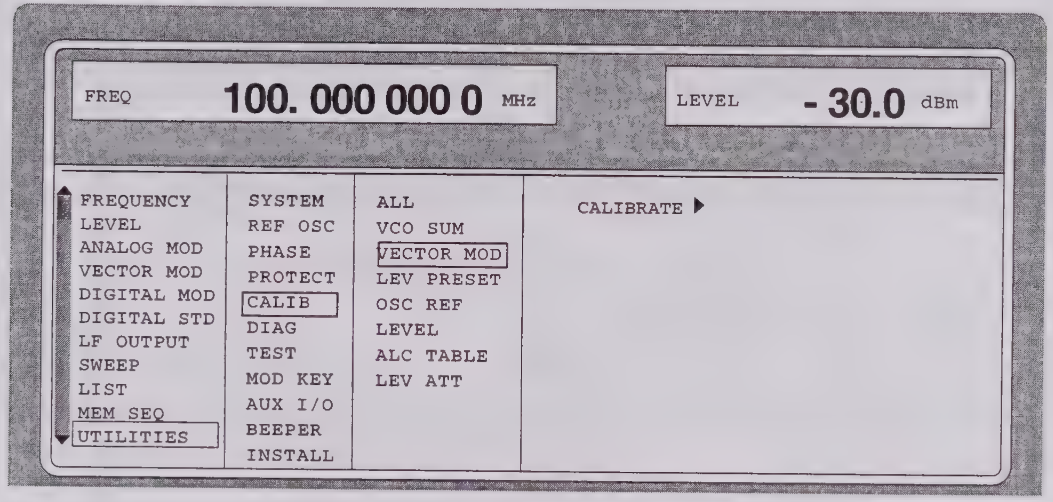
VIEW ▶ Indication of the list of correction values.
The cursor wraps to index 1 of the list. The list can be executed using the rotary knob. This index can be obtained by entering the index value on the digit block.

IEC/IEEE-bus command `:CAL:VSUM:OFFS?`
`:CAL:VSUM:DAC?`
`:CAL:VSUM:KOS?`

Calibration VECTOR MOD

In order to obtain accurate and reproducible measurements, the I/Q modulator has to be calibrated. To do this the internal calibration routine VECTOR MOD is used for adjusting the residual carrier, I/Q imbalance and quadrature offset of the modulator. Calibration should be carried out prior to the measurement but after a warm-up time of approx. 1 h or in the case of temperature changes of more than 5° C.

Menu selectiom: UTILITIES - CALIB - VECTOR MOD



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

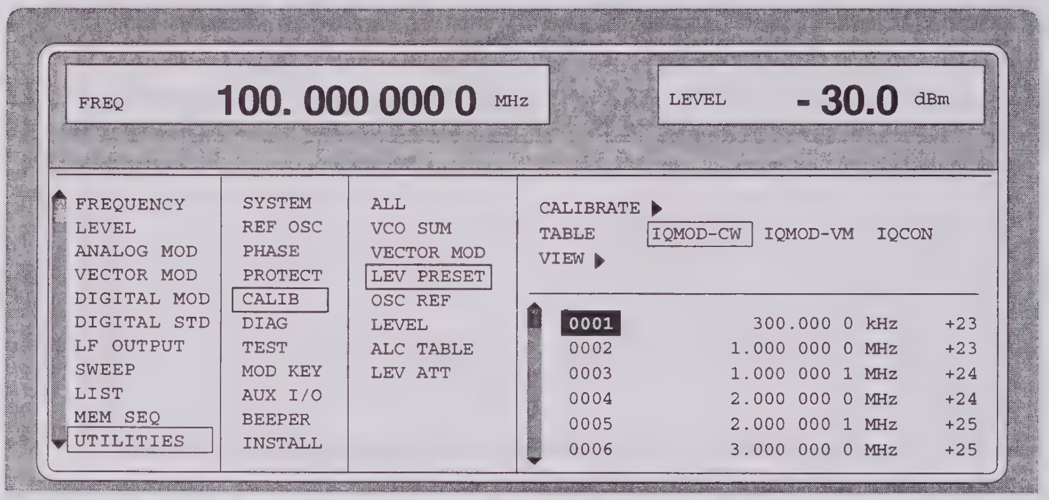
Fig. 2-207 Menu UTILITIES - CALIB - VECTOR MOD menu

CALIBRATE ▶ Triggers a calibration for the I/Q modulator, for FSIM, NDSIM and MCOD.
IEC/IEEE-bus command `:CAL:VMOD?`

Calibration LEV PRESET

The vector modulator is aligned in terms of residual carrier, IQ imbalance and quadrature. With options SMIQB10/B20 MCOD, SMIQB14/15 FSIM and SMIQB17 NDSIM provided, calibrations are called up for these modules too and the module offset and partly the IQ imbalance are calibrated. Since the calibrations are interdependent, calling up individual calibrations is not recommended. All calibrations are run internally. Calibration should be called up after a warm-up time of approx. 1 h or in case of a temperature change of more than 5°C .

Menu selection: UTILITIES - CALIB - LEV PRESET



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

TABLE IQMOD-CW IQMOD-VM IQCON

0001	300.000 0 kHz	+23
0002	1.000 000 0 MHz	+23
0003	1.000 000 1 MHz	+24
0004	2.000 000 0 MHz	+24
0005	2.000 000 1 MHz	+25
0006	3.000 000 0 MHz	+25

Fig. 2-208 Menu UTILITIES - CALIB - LEV PRESET

CALIBRATE ▶ Triggers the calibration for level preset.

IEC/IEEE-bus command `:CAL:LPR?`

The following parameters are only necessary for the indication of the correction values:

TABLE Selection of the correction values displayed by VIEW

IQMOD-CW	Correction values of module "IQ-Modulator", valid with CW mode
IQMOD-VM	Correction values of module "IQ-Modulator", valid with IQ mode
CONVERTER	Correction values of module "IQ-Converter"

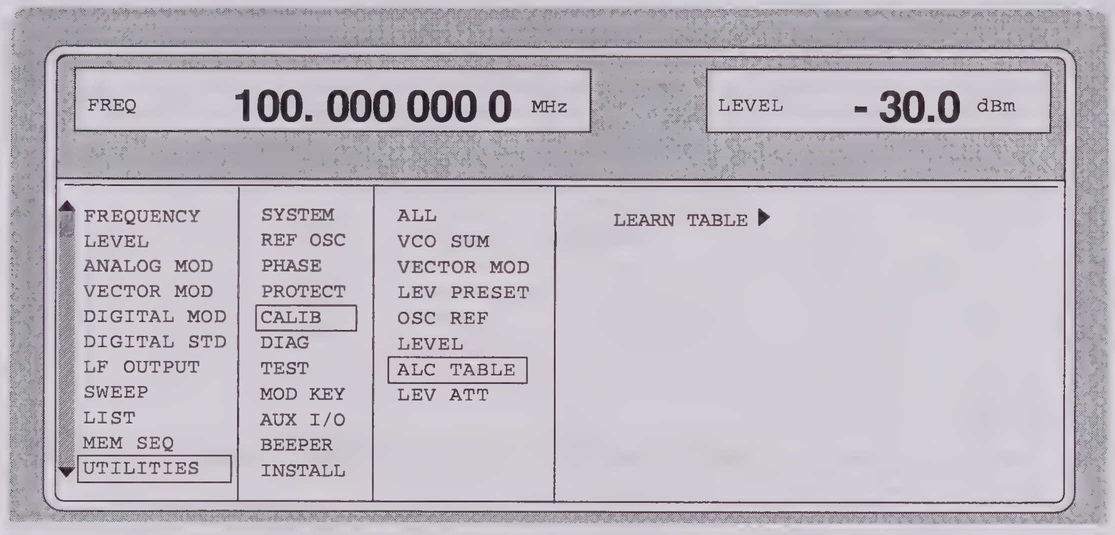
VIEW ▶ The cursor wraps to index 1 of the list. The list can be executed using the rotary knob. This index can be directly obtained by entering the index value on the digit block.

IEC/IEEE-bus command `:CAL:LPR:DATA?`

Calibration ALC TABLE

For vector modulation or digital modulation, SMIQ is operated with the internal level control switched off. In mode ALC MODE - SAMPLE & HOLD, the level is recalibrated for each level or frequency setting. In mode TABLE, the latter does not apply since the necessary input values are taken from a table. This table can be regenerated using LEARN TABLE ▶. This is required to attain an optimum level accuracy for the given operating temperature.

Menu selection: UTILITIES - CALIB - ALC TABLE



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

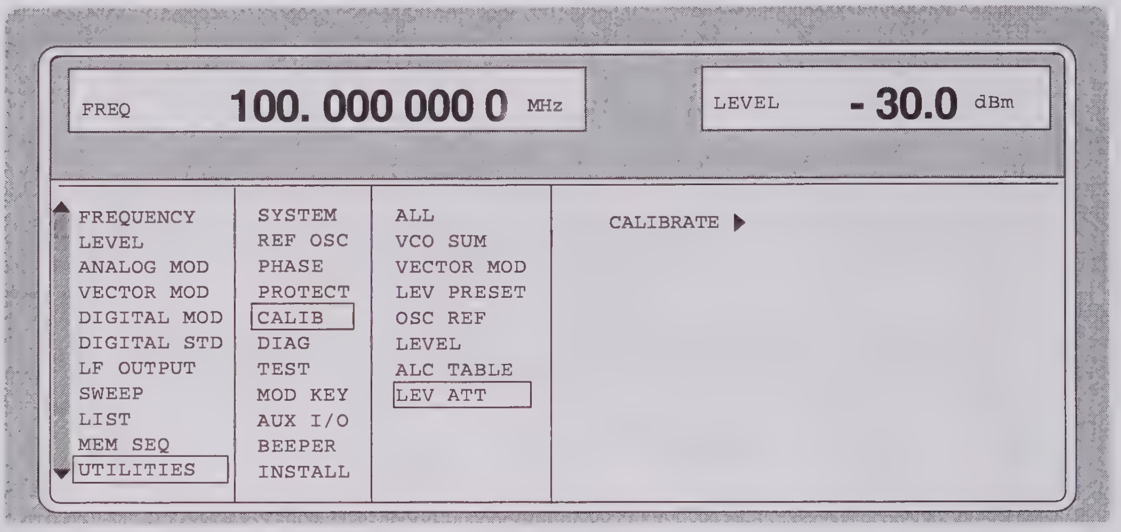
Fig. 2-209 Menu UTILITIES - CALIB - ALC TABLE

LEARN TABLE ▶	Triggers the generation of the new correction value for the function LEVEL-ALC-ALC OFF MODE TABLE. IEC/IEEE-bus command `:SOUR:POW:ALC:TABL?`

Calibration LEV ATT

For digital modulation (DIGITAL MOD and DIG STANDARD) and with the function LEV ATT switched on, the output level of SMIQ is reduced by a settable value in dB for a certain time (eg a slot). Calibration serves for attaining an optimum accuracy of level reduction.

Menu selection: UTILITIES - CALIB - LEV ATT



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

Fig. 2-210 Menu UTILITIES - CALIB - LEV ATT

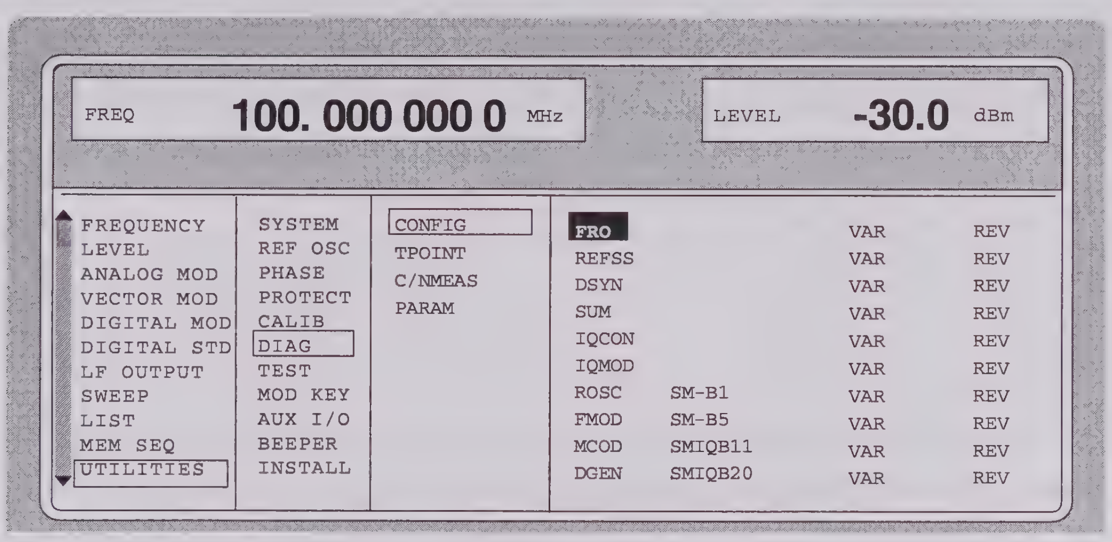
CALIBRATE ▶ Triggers the calibration for the function LEV ATT.
IEC/IEEE-bus command `:CAL:LATT?`

2.25.10 Indications of Module Variants (DIAG-CONFIG)

For service purposes, the modules installed can be indicated with their variants and states of modification. Submenu DIAG-CONFIG offers access to the module indication.

IEC/IEEE-bus command `:DIAG:INFO:MOD?`

Menu selection: UTILITIES - DIAG - CONFIG



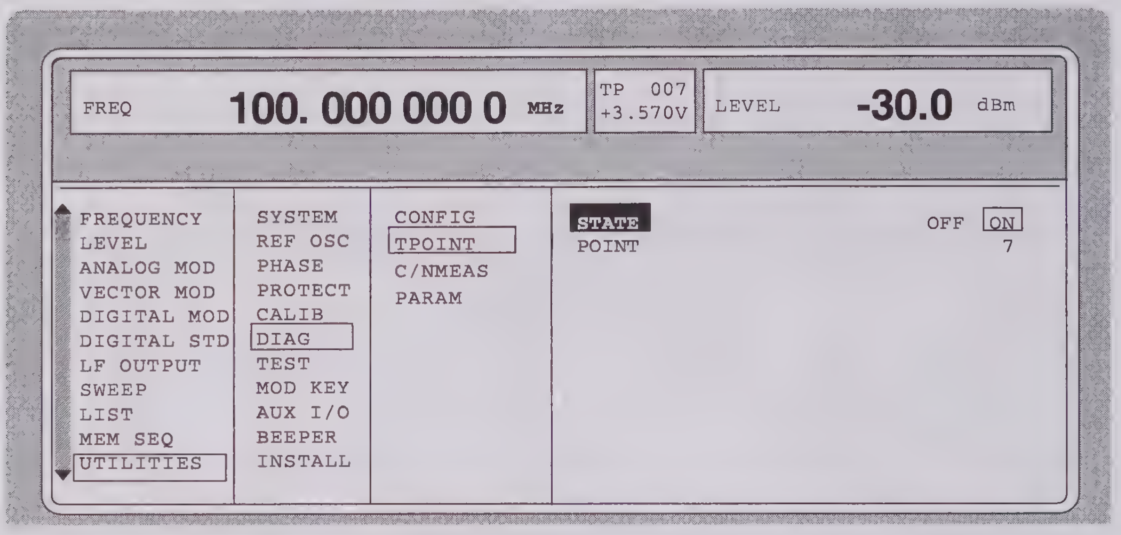
```
FRO                  VAR     REV
REFSS                VAR     REV
DSYN                 VAR     REV
SUM                  VAR     REV
IQCON                VAR     REV
IQMOD                VAR     REV
ROSC     SM-B1       VAR     REV
FMOD     SM-B5       VAR     REV
MCOD     SMIQB11     VAR     REV
DGEN     SMIQB20     VAR     REV
```

Fig. 2-211 Menu UTILITIES - DIAG - CONFIG

2.25.11 Voltage Indication of Test Points (DIAG-TPOINT)

Submenu DIAG-TPOINT offers access to internal test points. If a test point is switched on, the voltage indication is displayed in a window in the header field. For greater detail, see service manual.

Menu selection: UTILITIES - DIAG - TPOINT



STATE OFF ON

POINT 7

Fig. 2-212 Menu UTILITIES - DIAG - TPOINT

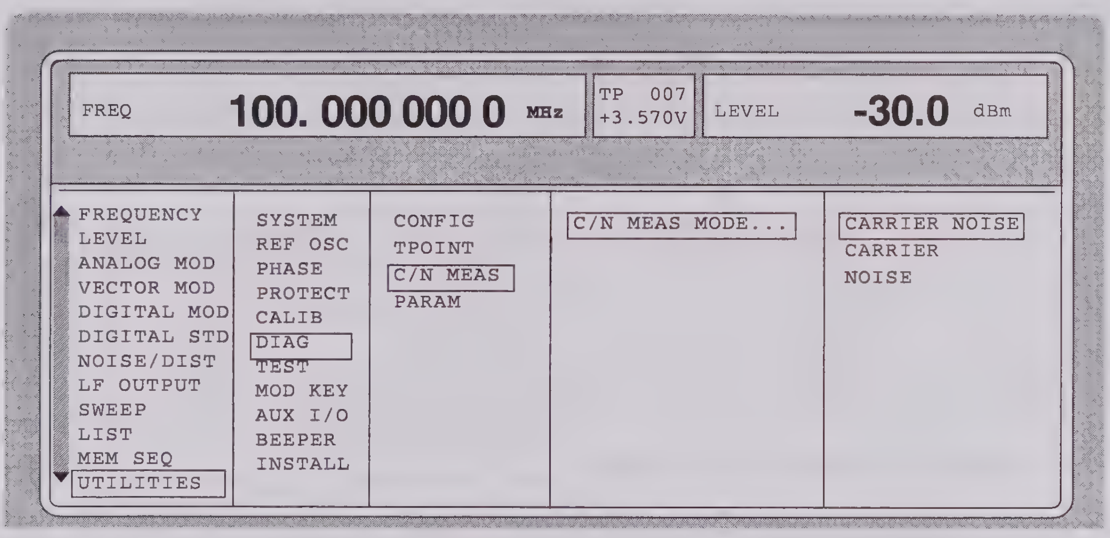
STATE Switching on/off the voltage indication in the header field.

POINT........... Input value of the test point.
IEC/IEEE-bus command `:DIAG:POINxx?`

2.25.12 Measurement of CARRIER/NOISE RATIO (DIAG-C/N MEAS)

The submenu DIAG - C/N MEAS can only be called with the option SMIQB17 (Noise generator and distortion simulator). For C/N measurements in servicing the generator can be set to the service modes as far are concerned. The carrier/noise ratio can then be easily determined this way. The submenu DIAG - C/N MEAS offers an access to these modes.

Menu selection: UTILITIES - DIAG - C/N MEAS



FREQ 100. 000 000 0 MHz

TP 007 +3.570V

LEVEL -30.0 dBm

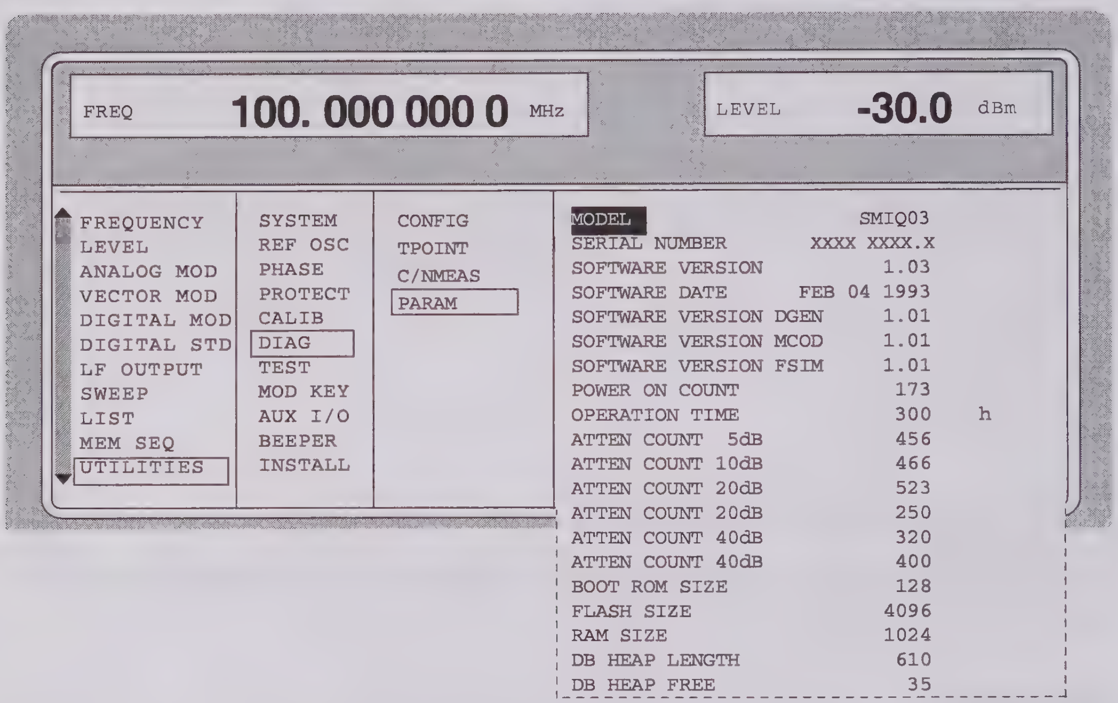
Fig. 2-213 Menu UTILITIES - DIAG - C/N MEAS

CARRIER NOISE	Noise and carrier signal	
	IEC/IEEE-bus command	`:DIAG:CNM:MODE CN`
CARRIER	Only carrier signal	
	IEC/IEEE-bus command	`:DIAG:CNM:MODE CARR`
NOISE	Only noise signal	
	IEC/IEEE-bus command	`:DIAG:CNM:MODE NOIS`

2.25.13 Indications of Service Data (DIAG-PARAM)

Submenu DIAG-PARAMETER offers access to different parameters such as serial number, software version, operating-hours counter and attenuator circuits.

Menu selection: UTILITIES - DIAG - PARAM



```
MODEL                          SMIQ03
SERIAL NUMBER             XXXX XXXX.X
SOFTWARE VERSION                 1.03
SOFTWARE DATE             FEB 04 1993
SOFTWARE VERSION DGEN            1.01
SOFTWARE VERSION MCOD            1.01
SOFTWARE VERSION FSIM            1.01
POWER ON COUNT                    173
OPERATION TIME                    300    h
ATTEN COUNT  5dB                  456
ATTEN COUNT 10dB                  466
ATTEN COUNT 20dB                  523
ATTEN COUNT 20dB                  250
ATTEN COUNT 40dB                  320
ATTEN COUNT 40dB                  400
BOOT ROM SIZE                     128
FLASH SIZE                       4096
RAM SIZE                         1024
DB HEAP LENGTH                    610
DB HEAP FREE                       35
```

Fig. 2-214 Menu UTILITIES - DIAG - PARAM

For IEC-bus commands, cf. Chapter 3, Section "DIAGnostic System" and Section "Common Commands; *IDN?".

2.25.14 Test (TEST)

(cf. Chapter 4, Section "Functional Test")

2.25.15 Assigning Modulations to the [MOD ON/OFF] Key (MOD-KEY)

The modulations can be switched on/off in the individual modulation menus and parallely by means of the [MOD ON/OFF] key.

For which modulations the [MOD ON/OFF] key is effective can be defined in the UTILITIES-MOD KEY menu. The key can either be effective for all modulations or for a selected one.

Function of the [MOD ON/OFF] key if effective for a type of modulation:

➢ Every pressing a key alters the state (ON or OFF) of the selected modulation.

Function of the [MOD ON/OFF] key if effective for all types of modulation (ALL):

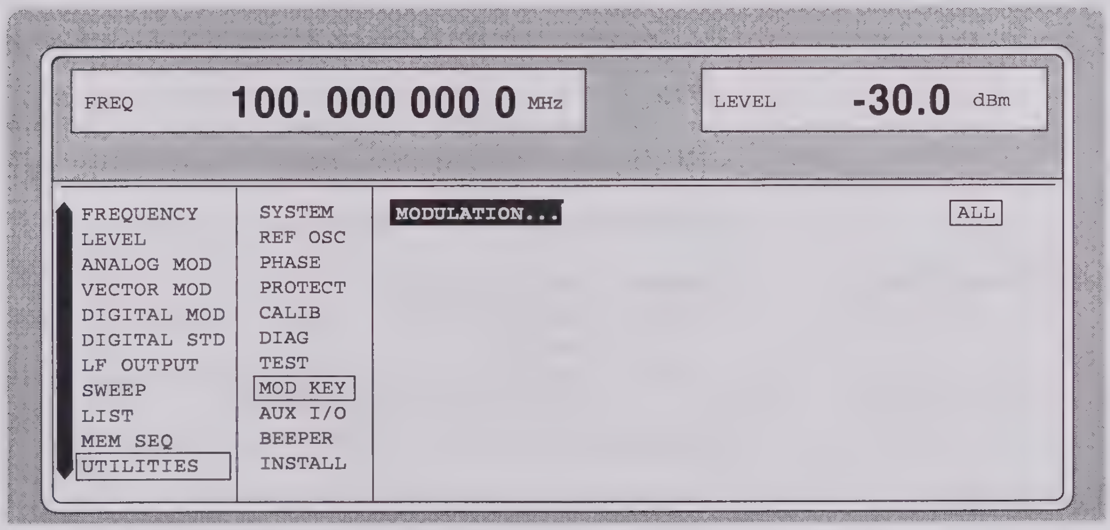
➢ If at least one modulation is switched on, pressing the [MOD ON/OFF] key switches the modulation/s off. Which modulations were switched on is stored.

If no modulation is switched on, pressing the [MOD ON/OFF] key switches on the modulations which were last switched off using the [MOD ON/OFF] key.

On switching on using the [MOD ON/OFF] key, the modulation sources are used as defined in the modulation menus.

Access to the selection of the modulation to be switched using the [MOD ON/OFF] key is possible in the UTILITIES-MOD KEY menu.

Menu selection: UTILITIES - MOD KEY



FREQ 100. 000 000 0 MHz

LEVEL -30.0 dBm

MODULATION... ALL

Fig. 2-215 Menu UTILITIES - MOD KEY (preset setting)

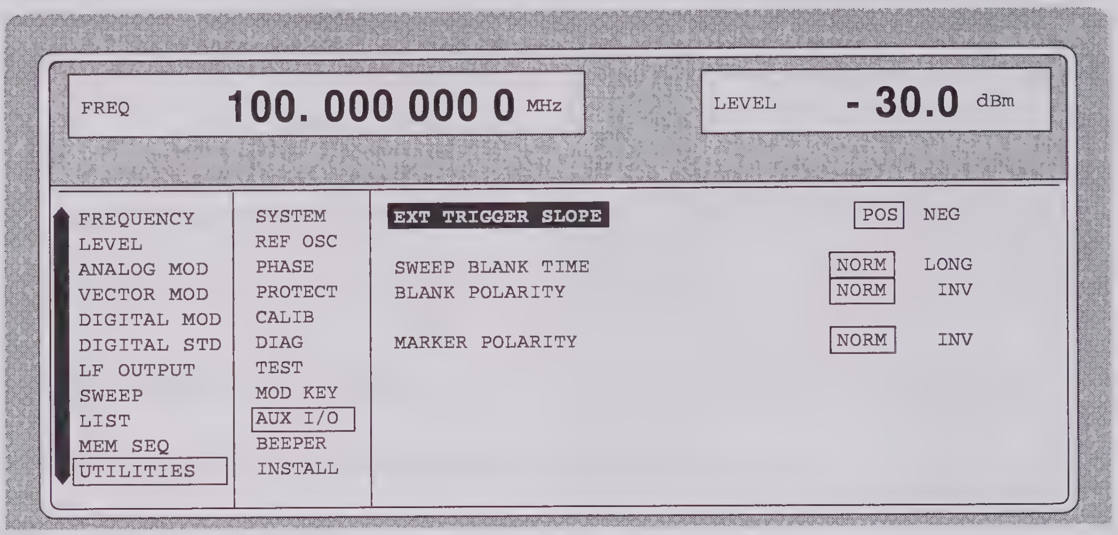
MODULATION Open a window for selection of the modulation for which the [MOD ON/OFF] key is to be effective. The following is to choose from: ALL, AM, BB-AM, FM, PM, PULSE, DM, VM, FSIM, DISTO, NOISE.

Note: *Preset switches off all modulations, sets the selection to ALL and stores AM 30%, AM SOURCE INT as default setting.*

2.25.16 Setting Auxiliary Inputs/Outputs (AUX-I/O)

Menu UTILITIES - AUX I/O offers access to settings for the TRIGGER input, BLANK output and MARKER output. Sections Sweep, LIST Mode and Memory Sequence provide further information.

Menu selection: UTILITIES - AUX I/O



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

EXT TRIGGER SLOPE [✓ POS] NEG

SWEEP BLANK TIME [✓ NORM] LONG

BLANK POLARITY [✓ NORM] INV

MARKER POLARITY [✓ NORM] INV

Fig. 2-216 Menu UTILITIES - AUX I/O

EXT TRIGGER SLOPE

Selection of the active edge of the external trigger signal.

POS	The instrument triggers on the positive edge of the external signal.
NEG	The instrument triggers on the negative edge of the external signal.

IEC/IEEE-bus command `:TRIG:SLOP POS`

SWEEP BLANK TIME

Selection of the blank duration.

NORM	BLANK duration is set to the shortest duration possible.
LONG	The BLANK duration is set for the PEN LIFT control of an XY recorder (approx. 500ms).

IEC/IEEE-bus command `:SOUR2:SWE:BTIM NORM`

BLANK POLARITY

Selection of the polarity for the blank signal.

NORM	With active BLANK, the output signal is HIGH.
INV	Polarity is inverted.

IEC/IEEE-bus command `:OUTP:BLAN NORM`

MARKER POLARITY

Selection of the polarity for the marker signal.

NORM	The output signal is HIGH when the sweep cycle reaches the mark.
INV	Polarity is inverted.

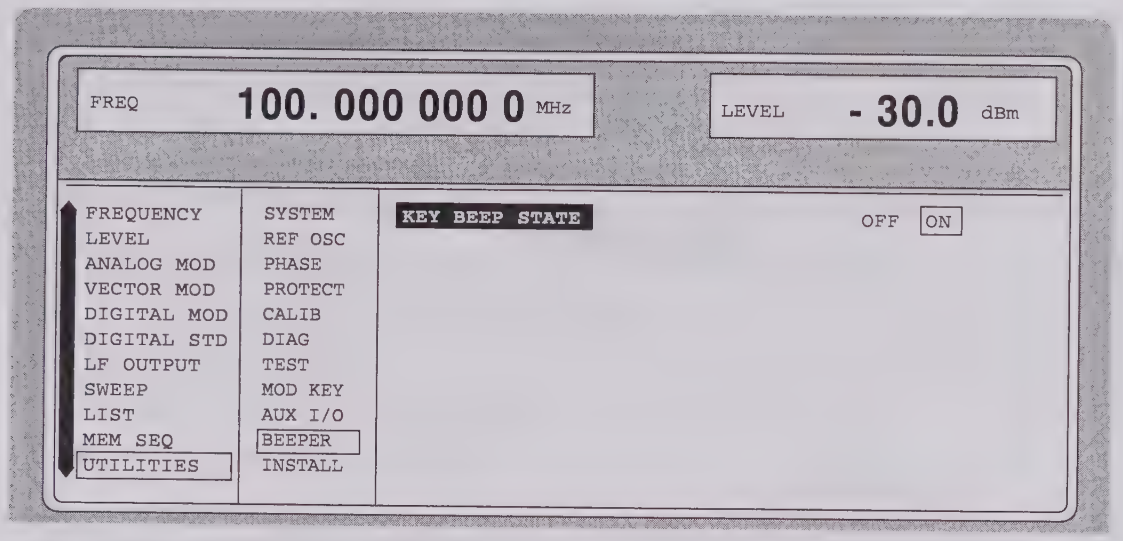
IEC/IEEE-bus command `SOUR:MARK:POL NORM`

2.25.17 Switching On/Off Beeper (BEEPER)

Menu UTILITIES-BEEPER offers access to the switching on/off of the beeper.

Note: *Preset does not alter the current state (ON or OFF).*

Menu selection: UTILITIES - BEEPER



FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

KEY BEEP STATE OFF ON

Fig. 2-217 Menu UTILITIES - BEEPER

KEY BEEP STATE Switching on/off the beeper

IEC-bus command `:SYST:BEEP:STAT ON`

2.25.18 Installation of Software Option

Optionss are installed in the menu UTILITIES-INSTALL by means of a keyword. The keyword is part to the equipment supplied in case of a follow-up order.

Menu UTILITIES-INSTALL gives access to the keyword entry.

Menu selection: UTILITIES - INSTALL

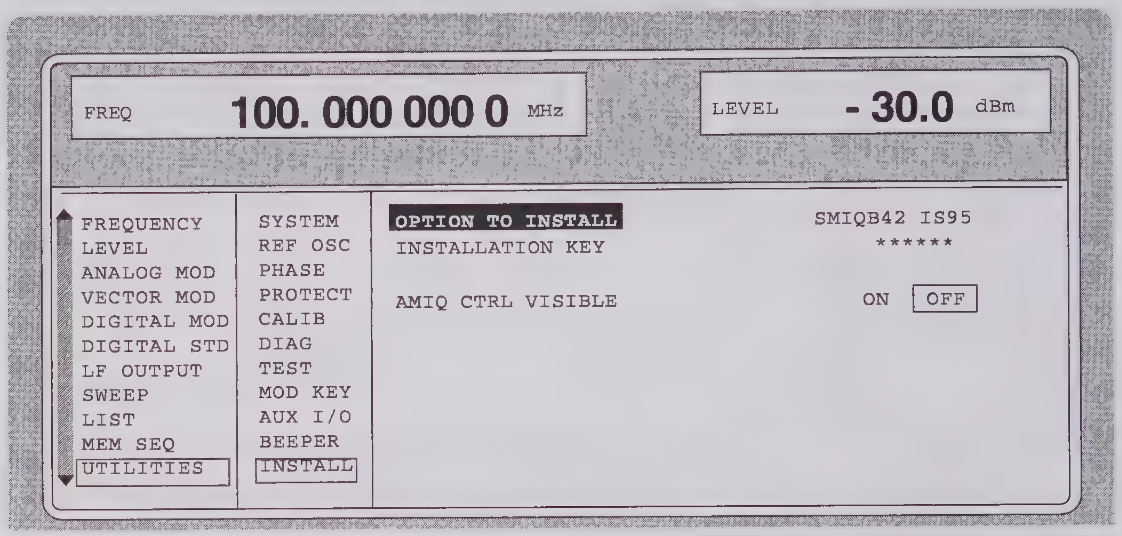

FREQ 100. 000 000 0 MHz
LEVEL - 30.0 dBm
OPTION TO INSTALL SMIQB42 IS95
INSTALLATION KEY ******
AMIQ CTRL VISIBLE ON OFF

Fig. 2-218 Menu UTILITIES - INSTALL, fitted with options

OPTION TO INSTALL	Selection of the option to be installed.
INSTALLATION KEY	Entry of the keyword; after entry, press key [ENTER].
AMIQ CTRL VISIBLE	Activates or deactivates menu AMIQ CTRL.

2.26 The Help System

The SMIQ has two help systems. On the one hand the context-sensitive help which is called by means of the HELP key and which gives information on the current menu. On the other hand, auxiliary texts can be selected according to headwords in alphabetical order by accessing menu HELP.

HELP Key

The yellow HELP key can be pressed at any point in time. The current setting menu is faded out and context-sensitive text faded in. The help panel can be exited by means of the RETURN key.

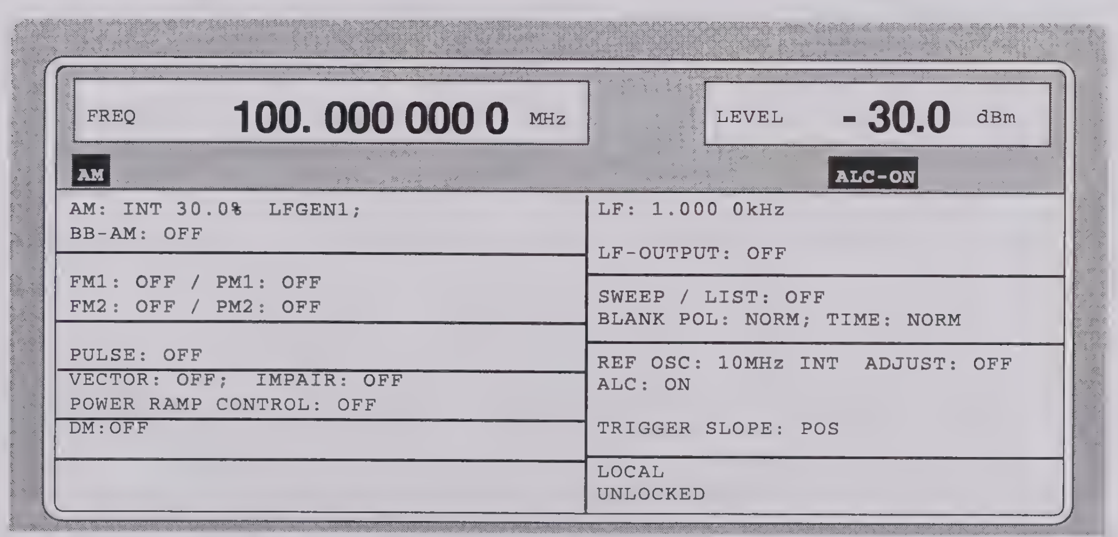
Menu HELP

After calling the help menu, access to all auxiliary texts is possible via an index. Operation is analog to menu operation.

- ➢ Set the menu cursor to the index desired using the shaft encoder.
- ➢ Press the [SELECT] key.
- ➢ The information for the index marked is displayed.
- ➢ Press the [RETURN] key to exit the menu.

2.27 Status

By means of a STATUS page, the SMIQ permits an overview over all settings of the instrument. The settings are displayed in an abbreviated form. The STATUS page is called by pressing the [STATUS] key. Return to the preceding menu is effected using the [RETURN] key.



```
FREQ   100. 000 000 0 MHz              LEVEL   - 30.0  dBm
AM                                                 ALC-ON
AM: INT 30.0%  LFGEN1;              LF: 1.000 0kHz
BB-AM: OFF
                                    LF-OUTPUT: OFF
FM1: OFF / PM1: OFF                 SWEEP / LIST: OFF
FM2: OFF / PM2: OFF                 BLANK POL: NORM; TIME: NORM

PULSE: OFF                          REF OSC: 10MHz INT  ADJUST: OFF
VECTOR: OFF;  IMPAIR: OFF           ALC: ON
POWER RAMP CONTROL: OFF
DM:OFF                              TRIGGER SLOPE: POS

                                    LOCAL
                                    UNLOCKED
```

Fig. 2-219 Menu STATUS page

2.28 Error Messages

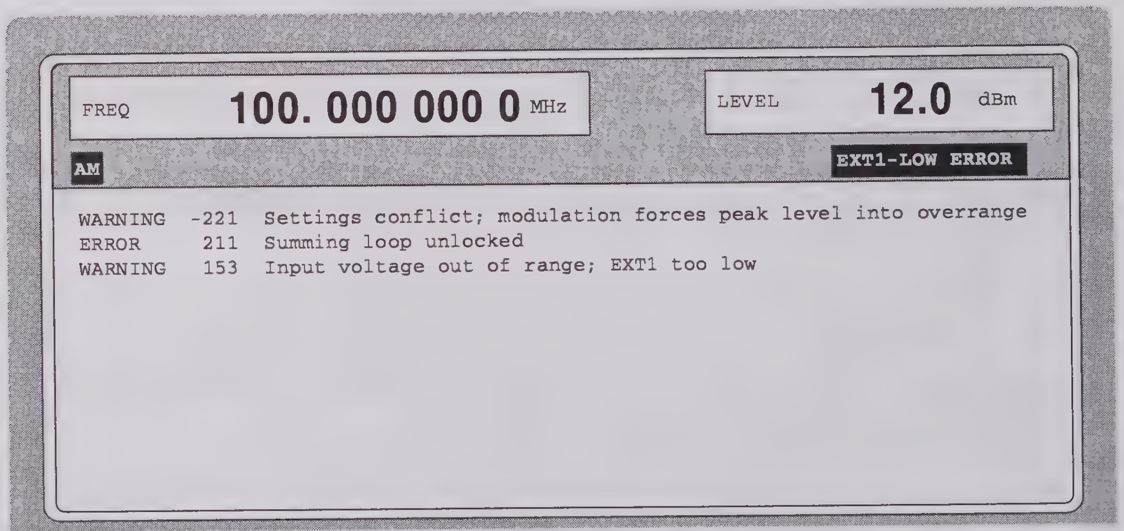
The SMIQ displays error and caution messages in a different manner, depending on how long, for a short period of time or permanently, the cause exists.

Short-term message	The short-term message is displayed in the status line. Part of it overwrites the status indications and disappears after approx. 2 seconds or in the case of a new entry. The instrument shows, e.g., short-term messages if the attempt is made to enter an overrange or if incompatible operating modes deactivate one another.
Long-term message	The long-term message is displayed in the status line by means of the message "WARNING" or "ERROR". Pressing the [ERROR] key calls the ERROR page in which the messages are entered. Several messages can be entered at the same time. The long-term message remains existing until there is no cause any more. The ERROR page is exited using the [RETURN] key. The instrument displays, e.g., the long-term message "ERROR" if there is a hardware error or "WARNING" if overrange settings have been made.

Notes: – *An error message "ERROR" does not necessarily point to a defect instrument. There are various operating states which can cause an ERROR message. E. g. if the instrument is set to external reference but no external reference is connected.*

– *Error 313 indicates the loss of calibration data and is also applicable in case of a cold start (key [PRESET] is pressed during switch-on). The calibration values can be restored with internal calibration routines. These routines are accessible via menu UTILITIES-CALIB (see section on calibration).*

The ERROR page offers access to long-term messages if the [ERROR] key is pressed.



FREQ 100. 000 000 0 MHz

LEVEL 12.0 dBm

```
WARNING  -221  Settings conflict; modulation forces peak level into overrange
ERROR     211  Summing loop unlocked
WARNING   153  Input voltage out of range; EXT1 too low
```

Fig. 2-220 ERROR page

A list of the possible error messages is to be found in annex B.

3 Remote Control

The instrument is equipped with an IEC-bus interface according to standard IEC 625.1/IEEE 488.2 and a RS-232 interface. The connectors are located at the rear of the instrument and permit to connect a controller for remote control. The instrument supports the SCPI version 1994.0 (Standard Commands for Programmable Instruments). The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers.

This section assumes basic knowledge of IEC-bus programming and operation of the controller. A description of the interface commands is to be obtained from the relevant manuals.
The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the respective sections. Tables provide a fast overview of the commands implemented in the instrument and the bit assignment in the status registers. The tables are supplemented by a comprehensive description of every command and the status registers. Detailed program examples of the main functions are to be found in annex D. The program examples for IEC-bus programming are all written in QuickBASIC.

Note: *In contrast to manual control, which is intended for maximum possible operating convenience, the priority of remote control is the predictability of the device status. This means that when incompatible settings (e.g. activation of PM and FM at the same time) are attempted, the command is ignored and the device status remains unchanged, i.e. is not adapted to other settings. Therefore, IEC/IEEE-bus control programs should always define an initial device status (e.g. with command *RST) and then implement the required settings.*

3.1 Brief Instructions

The short and simple operating sequence given below permits fast putting into operation of the instrument and setting of its basic functions.

3.1.1 IEC-Bus

It is assumed that the IEC-bus address, which is factory-set to 28 has not yet been changed.

1. Connect instrument and controller using IEC-bus cable.
2. Write and start the following program on the controller:

```
CALL IBFIND("DEV1", generator%)                        Open port to the instrument
CALL IBPAD(generator%, 28)              Inform controller about instrument address
CALL IBWRT(generator%, "*RST;*CLS")                               Reset instrument
CALL IBWRT(generator%, "FREQ 50MHz")                       Set frequency to 50 MHz
CALL IBWRT(generator%, "POW -7.3dBm")                   Set output level -7.3m dBm
                       "OUTP:STAT ON"                         Switch on RF output
CALL IBWRT(generator%, "AM:SOUR INT")              Set AM modulation source LFGEN
CALL IBWRT(generator%, "AM:INT:FREQ 15kHz")    Set modulation frequency to 15 kHz
CALL IBWRT(generator%, "AM 30PCT")                    Set AM modulation depth 30%
CALL IBWRT(generator%, "AM:STAT ON")                                  Switch on AM
```

   An amplitude-modulated signal is now applied at the output of the instrument.

3. To return to manual control, press the LOCAL key at the front panel.

3.1.2 RS-232 Interface

It is assumed that the configuration of the RS-232 interface at the unit has not yet been changed.

1. Connect unit and controller using the 0-modem cable.
2. Enter the following command at the controller to configure the controller interface:
   mode com1: 9600, n, 8, 1
3. Create the following ASCII file:

	Switch instrument to remote control (Return key)
`*RST;*CLS`	Reset instrument
`FREQ 50MHz`	Set frequency 50 MHz
`POW -7.3dBm`	Set output level -7.3 dBm
`OUTP:STAT ON`	Switch on RF output
`AM:SOUR INT`	Set AM modulation source LFGEN
`AM:INT:FREQ 15kHz`	Set modulation frequency 15 kHz
`AM 30PCT`	Set AM modulation depth 30%
`AM:STAT ON`	Switch on AM
	(Return key)

4. Transfer ASCII file to unit via RS-232 interface. Enter the following command at the controller:

   copy <filename> com1:

   An amplitude-modulated signal is now applied at the output of the instrument.
5. To return to manual control, press the [LOCAL] key at the front panel.

3.2 Switchover to Remote Control

On power-on, the instrument is always in the manual operating state ("LOCAL" state) and can be operated via the front panel.

The instrument is switched to remote control ("REMOTE" state)

IEC-bus	as soon as it receives an addressed command from a controller.
RS-232	as soon as it receives either a carriage return <CR> (=0Dh) or a line feed <LF> (0Ah) from a controller.

During remote control, operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via IEC bus (see Sections 3.2.1.3 and 3.2.2.3). Switching from manual operation to remote control and vice versa does not affect the remaining instrument settings.

3.2.1 Remote Control via IEC Bus

3.2.1.1 Setting the Device Address

The IEC-bus address of the instrument is factory-set to 28. It can be changed manually in the UTILITIES-SYSTEM-GPIB-ADDRESS menu or via IEC bus. Addresses 0 to 30 are permissible.

Manually:

- ➤ Call UTILITIES-SYSTEM-GPIB-ADDRESS menu
- ➤ Enter desired address
- ➤ Terminate input using the [1x/ENTER] key

Via IEC bus:

`CALL IBFIND("DEV1", generator%)`	Open port to the instrument
`CALL IBPAD(generator%, 28)`	Inform controller about old address
`CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 20")`	Set instrument to new address
`CALL IBPAD(generator%, 20)`	Inform controller about new address

3.2.1.2 Indications during Remote Control

The state of the remote control is evident by the words "IEC REMOTE" or "LOCAL" on the STATUS page. The STATUS page is always displayed in the REMOTE state.
LOCKED indicates that the key [LOCAL] is disabled, i.e. switchover to manual operation is only possible via IEC/IEEE bus. With UNLOCKED indicated, switchover to manual control is possible via the key [LOCAL] (see also section 3.2.1.3).

3.2.1.3 Return to Manual Operation

Return to manual operation is possible via the front panel or the IEC bus.

Manually: ➤ Press the [LOCAL] key.

Notes:

- *Before switchover, command processing must be completed as otherwise switchover to remote control is effected immediately.*
- *The [LOCAL] key can be disabled by the universal command LLO (see annex A) in order to prevent unintentional switchover. In this case, switchover to manual mode is only possible via the IEC bus.*
- *The [LOCAL] key can be enabled again by deactivating the REN control line of the IEC bus (see annex A).*

Via IEC bus:

```
...
CALL IBLOC(generator%)
...
```

Set instrument to manual operation.

3.2.2 Remote Control via RS-232-Interface

3.2.2.1 Setting the Transmission Parameters

To enable an error-free and correct data transmission, the parameters of the unit and the controller should have the same setting. To prevent any problems during binary data transmission, the RS-232 interface is set for 8 data bits, no parity and 1 stop bit. This data format corresponds to the current IEEE P1174 standard. Parameters baud rate and handshake can be manually changed in menu UTILITIES-SYSTEM-RS-232.

- ➢ Call UTILITIES-SYSTEM-RS232 menu
- ➢ Select desired baudrate and handshake
- ➢ Terminate input using the [1x/ENTER] key

3.2.2.2 Indications during Remote Control

The state of the remote control is evident by the words "RS-232 REMOTE" or "LOCAL" on the STATUS page. The STATUS page is always displayed in the REMOTE state.

3.2.2.3 Return to Manual Operating

Return to manual operation is possible via the front panel.

➢Press the [LOCAL] key.

Note: *Before switchover, command processing must be completed as otherwise switchover to remote control is effected immediately.*

3.3 Messages

The messages transferred via the data lines of the IEC bus (see annex A) can be divided into two groups:

- **interface messages** and
- **device messages**.

3.3.1 Interface Message

Interface messages are transferred on the data lines of the IEC bus, the ATN control line being active. They are used for communication between controller and instrument and can only be sent by a controller which has the IEC-bus control. Interface commands can be subdivided into

- **universal commands** and
- **addressed commands.**

Universal commands act on all devices connected to the IEC bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in annex A.

Some control characters are defined for the control of the RS-232-interface (see annex A)

3.3.2 Device Messages (Commands and Device Responses)

Device messages are transferred on the data lines of the IEC bus, the "ATN" control line not being active. ASCII code is used. The device messages are largely identical for the two interfaces (IEC bus and RS232) .
A distinction is made according to the direction in which they are sent on the IEC bus:

- **Commands** are messages the controller sends to the instrument. They operate the device functions and request information.
  The commands are subdivided according to two criteria:

  1. According to the effect they have on the instrument:

Setting commands	cause instrument settings such as reset of the instrument or setting the output level to 1 volt.
Queries	cause data to be provided for output on the IEC-bus, e.g. for identification of the device or polling the active input.

  2. According to their definition in standard IEEE 488.2:

Common Commands	are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and selftest.
Device-specific commands	refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee (cf. Section 3.4.1).

- **Device responses** are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. Section 3.4.4).

Structure and syntax of the device messages are described in Section 3.4. The commands are listed and explained in detail in Section 3.5.

3.4 Structure and Syntax of the Device Messages

3.4.1 SCPI Introduction

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure. Fig. 3-1 illustrates this tree structure using a section of command system SOURce, which operates the signal sources of the devices. The other examples concerning syntax and structure of the commands are derived from this command system.
SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see Section 3.4.4, Responses to Queries).

3.4.2 Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note: *The commands used in the following examples are not in every case implemented in the instrument.*

Common Commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

Examples:

`*RST`	RESET, resets the device
`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable registers
`*ESR?`	EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy:

Device-specific commands are of hierarchical structure (see Fig. 3-1). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example: `SOURce` This key word denotes the command system `SOURce`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example: `:SOURce:FM:EXTernal:COUPling AC`

This command lies in the fourth level of the SOURce system. It sets the coupling of the external signal source to AC.

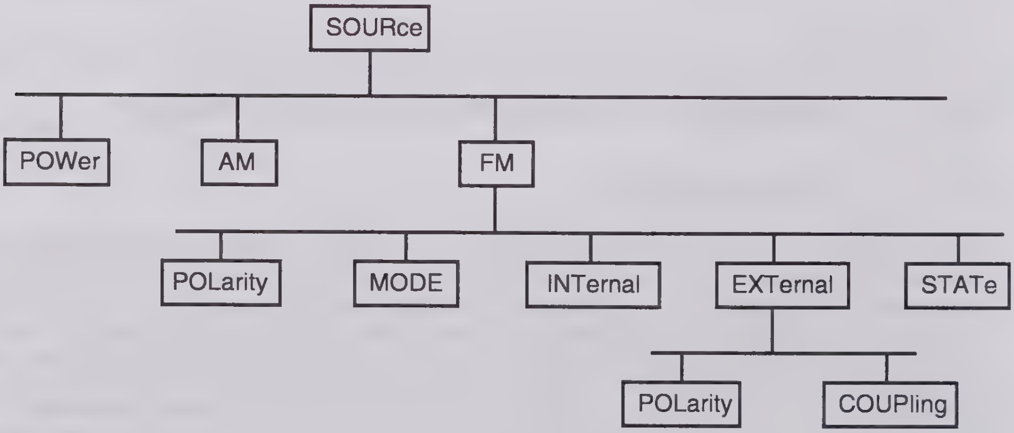


Fig. 3-1 Tree structure of the SCPI command systems using the SOURce system by way of example

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, that is to say, at which position in the header of a command they are inserted.

Example: `SOURce:FM:POLarity NORMal`
This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

`SOURce:FM:EXTernal:POLarity NORMal`
This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

Optional key words:

Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example: `[SOURce]:POWer[:LEVel][:IMMediate]:OFFSet 1`
This command immediately sets the offset of the signal to 1 volt. The following command has the same effect:
`POWer:OFFSet 1`

Note: *An optional key word must not be omitted if its effect is specified in detail by a numeric suffix.*

Long and short form:

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Example: `STATus:QUEStionable:ENABle 1= STAT:QUES:ENAB 1`

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serve the above purpose, the instrument itself does not make any difference between upper-case and lower-case letters.*

Parameter:

The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to Section 3.4.5.

Example: `SOURce:POWer:ATTenuation? MAXimum` Response: `60`
This query requests the maximal value for the attenuation.

Numeric suffix:

If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example: `SOURce:FM:EXTernal2:COUPling AC`
This command sets the coupling of the second external signal source.

3.4.3 Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. Quick BASIC automatically produces an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

```
CALL IBWRT(generator%, "SOURce:POWer:CENTer MINimum;:OUTPut:ATTenuation 10")
```

This command line contains two commands. The first command is part of the SOURce system and is used to specify the center frequency of the output signal. The second command is part of the OUTPut system and sets the attenuation of the output signal.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 3-1). The colon following the semicolon must be omitted in this case.

Example:

```
CALL IBWRT(generator%, "SOURce:FM:MODE LOCKed;:SOURce:FM:INTernal:FREQuency 1kHz")
```

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SOURce command system, subsystem FM, i.e. they have two common levels.
When abbreviating the command line, the second command begins with the level below SOURce:FM. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

```
CALL IBWRT(generator%,  "SOURce:FM:MODE LOCKed;INTernal:FREQuency 1kHz")
```

However, a new command line always begins with the complete path.

Example:

```
CALL IBWRT(generator%,  "SOURce:FM:MODE LOCKed")
CALL IBWRT(generator%,  "SOURce:FM:INTernal:FREQuency 1kHz")
```

3.4.4 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter is transmitted without header.
   Example: `SOURce:EXTernal:COUPling?` Response: `AC`
2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
   Example: `FREQuency? MAX` Response: `10E3`
3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
   Example: `FREQuency?` Response: `1E6` for 1 MHz
4. Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
   Example: `OUTPut:STATe?` Response: `1`
5. Text (character data) is returned in a short form (see also Section 3.4.5).
   Example: `SOURce:FM:SOURce?` Response: `INT`

3.4.5 Parameter

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description (see Section 3.5).

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). It the unit is missing, the basic unit is used.

Example: `SOURce:FREQuency 1.5 kHz = SOURce:FREQuency 1.5E3`

Special numerical values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the numerical value is provided.

Example: Setting command: `SOURce:VOLTage MAXimum`
Query: `SOURce:VOLTage?` Response: `15`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.

UP/DOWN — UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.

INF/NINF — INFinity, Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device responses.

NAN — Not a Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. 0 or 1 is provided in a query.

Example: Setting command: `SOURce:FM:STATe ON`
Query: `SOURce:FM:STATe?` Response: `1`

Text

Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example: Setting command: `OUTPut:FILTer:TYPE EXTernal`
Query: `OUTPut:FILTer:TYPE?` Response: `EXT`

Strings

Strings must always be entered in quotation marks (' or ").

Example: `SYSTem:LANGuage "SCPI"` or
`SYSTem:LANGuage 'SCPI'`

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example: `HEADer:HEADer #45168xxxxxxxx`

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted. Data elements comprising more than one byte are transmitted with the byte being the first which was specified by SCPI command "`FORMat:BORDer`". Here, the command `:SYSTem:COMMunicate:GPIB:LTERminator` EOI should be used to set the delimiter mode to 'circuit message EOI only' so that an accidental LF within the data sequence is not first identified as a delimiter and thus momentarily interrupts the data transmission. The command `...LTER STANdard` resets the delimiter mode.

The format of the binary files within the block depends on the IEC-bus command
The commands

```
:SOURce:LIST:DWELl
:SOURce:LIST:FREQuency
:SOURce:LIST:POWer
:SOURce:CORRection:CSET:DATA:FREQuency
:SOURce:CORRection:CSET:DATA:POWer
:SOURce:DATA:AM
:SOURce:DATA:AMBase
:SOURce:DATA:PM
:SOURce:DATA:PMBase
:SYSTem:MSEQuence:DWELl
:SYSTem:MSEQuence:RCL
```

use the IEEE-754 format for double precision floating point numbers. Each number is represented by 8 bytes.

Example:

a# = 125.345678E6
b# = 127.876543E6

```
CALL  IBWRT(generator%,  "SOURCE:CORRECTION:CSET:DATA:FREQ
#216" + MKD$(a#) + MKD$(b#))
```

- '#' in the command string introduces the binary block,
- '2' indicates that 2 digits specifying the length will follow next,
- '16' is the length of the binary block (in bytes), here: 2 double precision floating pooint number with 8 bytes each.
- The actual binary data follow now. As the function IBWRT requires a text string, MKD$ is used for the type conversion.

The following ASCII format has the same effect:

```
CALL  IBWRT(generator%,  "SOURCE:CORRECTION:CSET:DATA:FREQ
125.345678E6, 127.876543E6")
```

3.4.6 Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

:	The colon separates the key words of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterix marks a common command.
"	Quotation marks introduce a string and terminate it.
#	ASCI character # introduces block data.
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

3.5 Description of Commands

3.5.1 Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, separated according to the command system. The notation corresponds to the one of the SCPI standards to a large extent. The SCPI conformity information can be taken from the list of commands in annex C.

Table of Commands

Command:	In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).
Parameter:	In the parameter column the requested parameters are indicated together with their specified range.
Unit:	The unit column indicates the basic unit of the physical parameters.
Remark:	In the remark column an indication is made on - whether the command does not have a query form, - whether the command has only one query form , - whether this command is implemented only with a certain option of the instrument.

Indentations

The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level is, the farther the indentation to the right is. Please observe that the complete notation of the command always includes the higher levels as well.

Example: `:SOURce:FM:MODE` is represented in the table as follows:

`:SOURce`	first level
`   :FM`	second level
`      :MODE`	third level

In the individual description, the complete notation of the command is given. An example for each command is written out at the end of the individual description.

Upper/lower case notation

Upper/lower case letters serve to mark the long or short form of the key words of a command in the description (see Section 3.4.2). The instrument itself does not distinguish between upper and lower case letters.

Special characters | A selection of key words with an identical effect exists for several commands. These key words are indicated in the same line, they are separated by a vertical stroke. Only one of these key words has to be indicated in the header of the command. The effect of the command is independent of which of the key words is indicated.

Example:
```
:SOURce
   :FREQuency
      :CW|:FIXed
```

The two following commands of identical meaning can be formed. They set the frequency of the constantly frequent signal to 1 kHz:

```
SOURce:FREQuency:CW 1E3 = SOURce:FREQuency:FIXed 1E3
```

A vertical stroke in indicating the parameters marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is entered.

Example: Selection of the parameters for the command

```
SOURce:COUPling  AC | DC
```

If parameter AC is selected, only the AC content is fed through, in the case of DC, the DC as well as the AC content.

[ ] Key words in square brackets can be omitted when composing the header (cf. Section 3.4.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.
Parameters in square brackets can optionally be incorporated in the command or omitted as well.

{ } Parameters in braces can optionally be incorporated in the command either not at all, once or several times.

3.5.2 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. Same commands have the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in Section 3.7.

Table 3-1 Common Commands

Command	Parameter	Unit	Remark
***CLS**			No query
***ESE**	0 to 255		
***ESR?**			Only query
&GTL			
***IDN?**			Only query
***IST?**			Only query
***OPC**			
***OPC?**			Only query
***OPT?**			Only query
***PRE**	0 to 255		
***PSC**	0 | 1		
***RCL**	0 to 50		No query
***RST**			No query
***SAV**	1 to 50		No query
***SRE**	0 to 255		
***STB?**			Only query
***TRG**			No query
***TST?**			Only query
***WAI**			No query

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer

***ESE** 0 to 255

EVENT STATUS ENABLE sets the event status enable register to the value indicated. Query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

&GTL

GO TO LOCAL: The IEC bus (IEEE488) includes line message REN (remote enable). If the device is controlled via a serial interface (RS-232), a remote/local switchover is not possible with this line. This new command in line with IEEE1174 has been therefore introduced so that the device can be switched to local mode via remote control (in the same way as with the front-panel LOCAL key). The device automatically goes to the remote status as soon as the first remote command has been received. The command is also of importance when the device is to be controlled alternately via the IEC/IEEE bus and the serial interface. The device should go to local before it can recognize a command from the other interface.

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.
The device response is for example: `"Rohde&Schwarz, SMIQ03B,00000001, 1.03"`

`03B` = variant identification
`00000001`= serial number
`1.03` = firmware version number

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST flag is the status bit which is sent during a parallel poll (cf. Section 3.6.3.2).

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. Section 3.6).

***OPC?**

OPERATION COMPLETE QUERY returns 1, if all preceding commands have been executed. It is necessary to consider a sufficiently long time-out for the IEEE/IEC-bus.

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas. For every option, a fixed position is provided in the response.

Table 3-2 Device Response to *OPT?

Position	Option	
1	SM-B1	Reference oscillator OCXO
2	SM-B5	FM/PM modulator
3	SMIQB10	Modulation coder
4	SMIQB11	Data generator
5	SMIQB12	Memory extension for SMIQB11
6	SMIQB12	Second memory extension
7	SMIQB14	Fading simulator
8	SMIQB15	Second fading simulator
9	SMIQB16	Broadband FM
10	SMIQB17	Noise generator/distortion simulator
11	SMIQB20	Modulation coder
12	SMIQB43	Digital Standard W-CDMA
13	SMIQB45	Digital Standard 3GPP W-CDMA
14	SMIQB47	LOW ACP Filter
15	SM-B50	Fast CPU

Example for a device response:
`SM-B1,SM-B5,SMIQB10,SMIQB11,SMIQB12,SMIQB12,SMIQB14,SMIQB15,0`

***PRE** 0 to 255

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC** 0 | 1

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset in switching on.

*PSC = 0	causes the contents of the status registers to be maintained. Thus a service request can be triggered in switching on in the case of a corresponding configuration of status registers ESE and SRE.
*PSC ≠ 0	resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RCL** 0 to 50

RECALL calls the instrument state which was stored under the number supplied using command *SAV. 50 instrument states can be stored.

***RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the [PRESET] key. The state of the RF-output is an exception: The RF-output is deactivated after *RST, however, it is activated after the [RESET] key has been pressed. The default setting is indicated in the description of the commands.

***SAV** 1 to 50

SAVE stores the current instrument state under the number indicated (cf. *RCL as well).

***SRE** 0 to 255

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. Query *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

***TRG**

TRIGGER triggers all actions waiting for a trigger event. Special trigger events can be started by command system "TRIGger" (see section "TRIGger System").

***TST?**

SELF TEST QUERY triggers all selftests of the instrument indicated in Chapter 4, Section "Functional Test" and outputs an error code in decimal form.

***WAI**

WAIT-to-CONTINUE only permits the servicing of the subsequent commands after all preceding commands have been executed and all signals have settled (cf. Section 3.6 and "`*OPC`" as well).

3.5.3 ABORt System

The ABORt system contains the commands to abort actions triggered. After an action has been aborted, it can be triggered again at once. All commands trigger an event, thus they have no *RST value.

Further commands for the trigger system of the SMIQ can be found in the TRIGger system.

Command	Parameter	Default Unit	Remark
:ABORt			
[:SWEep]			No query
:LIST			No query
:MSEQuence			No query

:ABORt[:SWEep]

The command aborts a sweep.

Example: `:ABOR:SWE`

:ABORt:LIST

The command aborts a list execution.

Example: `:ABOR:LIST`

:ABORt:MSEQuence

The command aborts a Memory Sequence.

Example: `:ABOR:MSEQ`

3.5.4 CALibration-System

The CALibration system contains the commands to calibrate the SMIQ. On triggering the calibration by means of `:MEASure` , response "0" displays a faultless calibration, response "1" means that an error has occurred during calibration. As to the meaning of the data in the case of query `:DATA?`, cf. Chapter 2, Section "Calibration".

Command	Parameter	Default Unit	Remark
:CALibration			
:ALL			
:FSIM			
[MEAsure]?			Query only
:LATTenuation			
[:MEASure]?			Query only
:LEVel			
:DATA?			Query only
:STATe	ON | OFF		
:LPReset			
[:MEASure]?			Query only
:DATA?			Query only
:NDSim			
[:MEASure]?			Query only
:ROSCillator			
[:DATA]	0 to 4095		
:VSUMmation			
[:MEASure]?			Query only
:OFFS?			Query only
:DAC?			Query only
:KOS?			Query only
:VMODulation			
[:MEASure]?			Query only

:CALibration[:ALL]?

This command triggers all internal calibrations which do not require any external measuring equipment. The command triggers an event and thus has no *RST value.

Example: `:CAL:ALL?`

:CALibration:FSIM[:MEASure]?

The command triggers a calibration measurement of the DC offset of the fading simulator. The command triggers an event and thus has no *RST value.

Example: `:CAL:FSIM?`

:CALibration:LATTenuation[:MEASure]?

The command triggers a calibration measurement of the level attenuation of function envelope control. The command triggers an event and thus has no *RST value.

Example: `:CAL:LPR:MEAS?` Response: 0

:CALibration:LEVel

This node provides the commands for the management of the level correction table. The corresponding data are permanently stored in the instrument and cannot be changed. The instrument includes different level correction tables. The tables to be used are selected depending on the set frequency and modulation type. The `:STATe ON` command activates the level correction table corresponding to the instrument setup.

:CALibration:LEVel:DATA?

The command queries the level correction data. It returns all level correction data in the format fixed in the :FORMat system.

Example: `:CAL:LEV:DATA?`

:CALibration:LEVel:STATe ON | OFF

The command switches on or off internal level correction. *RST value is ON

Example: `:CAL:LEV:STAT OFF`

:CALibration:LPReset

The commands to measure the values for the level presetting table are under this node (Level PReset).

:CALibration:LPReset[:MEASure]?

The command triggers a calibration measurement. The command triggers an event and thus has no *RST value.

Example: `:CAL:LPR:MEAS?` Response: 0

:CALibration:LPReset:DATA?

The command queries the correction data. It returns all correction data in the format fixed in the :FORMat system.

Example: `:CAL:LPR:DATA?`

:CALibration:NDSim[:MEASure]?

This command triggers an offset calibration of module NDSIM.

Example: `:CAL:NDS?` Answer: 0 if OK, 1 if faulty

:CALibration:ROSCillator

The commands to calibrate the reference oscillator are under this node.

:CALibration:ROSCillator[:DATA] 0 to 4095

The command enters the correction data. For an exact definition of the calibration value, cf. Section 2.

Example: `:CAL:ROSC:DATA 2048`

:CALibration:VSUMmation

The commands to determine the support values for the frequency setting are under this node.

:CALibration:VSUMmation [:MEASure]?

The command triggers a calibration measurement. The command triggers an event and thus has no *RST value.

Example: `:CAL:VSUM:MEAS?` Answer: 0

:CALibration:VSUMmation:OFFS?
:CALibration:VSUMmation:DAC?
:CALibration:VSUMmation:KOS?

The commands query the calibration data (see service manual). they return all correction data in the format fixed in the :FORMat system.

Example: `:CAL:VSUM:OFFS?`

:CALibration:VMODulation[:MEASure]?

This command triggers a calibration measurement for the vector modulation. Since it triggers an event it has no default setting value.

Example: `:CAL:VMOD:MEAS?` Answer: 0

3.5.5 DIAGnostic-System

The DIAGnostic system contains the commands for diagnostic test and service of the instrument. SCPI does not define DIAGnostic commands, the commands listed here are SMIQ-specific. All DIAGnostic commands are queries which are not influenced by *RST. Hence no default setting values are stated.

Command	Parameter	Default Unit	Remark
:DIAGnostic			
:CLISt			
:CHECksum			
:CALCulate			
:DATA?			Query only
:CNMeasure			
:MODE	CN | CARRier | NOISe		
:DLISt			
:CHECksum			
:CALCulate			
:DATA?			Query only
:INFO			
:CCOunt			
:ATTenuator1|2|3|4|5|6?			Query only
:POWer?			Query only
:MODules?			Query only
:OTIMe?			Query only
:SDATe?			Query only
[:MEASure]			
:POINt?			Query only

:DIAGnostic:CLISt:CHECksum:CALculate

This command calculates the checksum of the currently selected control list (see Digital Modulation CLISt).

Example: `:DIAG:CLIS:CHEC:CALC`

:DIAGnostic:CLISt:CHECksum:DATA?

This command displays the checksum calculated before in hexadecimal representation (see above) .

Example: `:DIAG:CLIS:CHEC:DATA?` Response: `1234567`

:DIAGnostic:CNMeasure:MODE CN | CARRier | NOISe

This command switches on or off the usefull or noise signal for C/N (carrier/noise ratio) measurements. The following modes can be selected:

CN	carrier and noise signal
CARRier	carrier signal only
NOISe	noise signal only

Example: `:DIAG:CNM:MODE CN` *RST value is CN

:DIAGnostic:DLISt:CHECksum:CALculate

This command calculates the checksum of the currently selected control list (see Digital Modulation DLISt).

Example: `:DIAG:DLIS:CHEC:CALC`

:DIAGnostic:DLISt:CHECksum:DATA?

This command displays the checksum calculated before in hexadecimal representation (see above).

Example: `:DIAG:DLIS:CHEC:DATA?` Response:1234567

:DIAGnostic:INFO

The commands which can be used to query all information which does not require hardware measurement are under this node.

:DIAGnostic:INFO:CCOunt

The commands which can be used to query all counters in the instrument are under this node (Cycle COunt).

:DIAGnostic:INFO:CCOunt:ATTenuator 1 | 2 | 3 | 4 | 5 | 6?

The command queries the number of switching processes of the different attenuator stages. The stages are designated with Z1 to Z6 within the instrument. In this command they are differentiated by a numeric suffix whose name corresponds to the number:

Suffix	Name	Function
1	Z1	40-dB stage
2	Z2	20-dB stage
3	Z3	5-dB stage
4	Z4	20-dB stage
5	Z5	10-dB stage
6	Z6	40-dB stage

Example: `:DIAG:INFO:CCO:ATT1?` Response: `1487`

:DIAGnostic:INFO:CCOunt:POWer?

The command queries the number of switch-on processes.

Example: `:DIAG:INFO:CCO:POW?` Response: `258`

:DIAGnostic:INFO:MODules?

The command queries the modules existing in the instrument with their model and state-of-modification numbers. The response supplied is a list in which the different entries are separated by commas. The length of the list is variable and depends on the equipment of the instrument. Each entry consists of three parts which are separated by means of blanks:

1. Name of module; 2. Variant of module in the form VarXX (XX = 2 digits)

3. Revision of module in the form RevXX (XX = 2 digits)

Example `:DIAG:INFO:MOD?` Response: FRO Var01 Rev00, DSYN Var03 Rev12, to...

:DIAGnostic:INFO:OTIMe?

The command reads out the internal operating-hours counter. The response supplies the number of hours the instrument has been in operation up to now.

Example: `:DIAG:INFO:OTIM?` Response: `19`

:DIAGnostic:INFO:SDATe?

The command queries the date of software creation. The response is returned in the form month, day, year.

Example: `:DIAG:INFO:SDAT?` Response: `Dec 15 1998`

:DIAGnostic:[:MEASure]

The commands which trigger a measurement in the instrument and return the measured value are under this node.

:DIAGnostic[:MEASure]:POINt?

The command triggers a measurement at a measuring point and returns the voltage measured. The measuring point is specified by a numeric suffix (cf. service manual, stock no. 1085.2445.24).

Example: `:DIAG:MEAS:POIN2?` Response: `3.52`

3.5.6 DISPLAY-System

This system contains the commands to configure the screen. If system security is activated using command `SYSTem:SECurity ON`, the display cannot be switched on and off arbitrarily (cf. below)

Command	Parameter	Default Unit	Remark
:DISPlay			
:ANNotation			
[:ALL]	ON | OFF		
:AMPLitude	ON | OFF		
:FREQuency	ON | OFF		

:DISPlay:ANNotation

The commands determining whether frequency and amplitude are indicated under this node.

Caution: *With SYSTem:SECurity ON, the indications cannot be switched from OFF to ON. In this case *RST does not influence the ANNotation settings either. With SYSTem:SECurity OFF, the *RST value is ON for all ANNotation parameters.*

:DISPlay:ANNotation[:ALL] ON | OFF

The command switches the frequency and amplitude indication on or off.

Command `:DISPlay:ANNotation:ALL ON` can only be executed if `SYSTem:SECurity` is set to `OFF`.

Example: `:DISP:ANN:ALL ON` With `SECurity OFF` - *RST value is ON

:DISPlay:ANNotation:AMPLitude ON | OFF

The command switches on or off the amplitude indication.

Command `:DISPlay:ANNotation:AMPLitude ON` can only be executed if `SYSTem:SECurity` is set to `OFF`.

Example: `:DISP:ANN:AMPL ON` With `SYSTem:SECurity OFF` - *RST value is ON

:DISPlay:ANNotation:FREQuency ON | OFF

The command switches on or off the frequency indication.

Command `:DISPlay:ANNotation:FREQuency ON` can only be executed if `SYSTem:SECurity` is set to `OFF`.

Example: `:DISP:ANN:FREQ ON` With `SYSTem:SECurity OFF` - *RST value is ON

3.5.7 FORMat-System

This system contains the commands determining the format of the data the SMIQ returns to the controller. All queries returning a list of numeric data or block data are concerned. With each of these commands, this connection is pointed to in the description.

Command	Parameter	Default Unit	Remark
:FORMat			
[:DATA]	ASCii | PACKed		
:BORDer	NORMal | SWAPped		

:FORMat[:DATA] ASCii I PACKed

The command specifies the data format, that the SMIQ uses for returning the data. When data are transmitted from the controller to the SMIQ, the SMIQ recognizes the data format automatically. In this case, the value specified here has no significance.

Note: *Settings using the FORMat:DATA command are only effective for commands with which this is stated in the command description.*

ASCii	Numeric data are transmitted in plain text, separated by commas.
PACKed	Numerical data are transmitted as binary block data. The format of the binary data itself is command-specific. Its description can be found in Section 3.4.5.

Example: `:FORM:DATA ASC` *RST value is ASCii

:FORMat:BORDer NORMal I SWAPped

This command defines the order of bytes inside a binary block. This concerns only blocks which use the IEEE754 format internally (see section 3.4.5, paragraph "Block Data").

NORMal:	The SMIQ expects (for setting commands) and sends (for queries) first the most significant byte of each IEEE-754 floating point number, last the least significant byte. For hosts based on a 80x86 processor this corresponds to the configuration of bytes in the main memory. Thus, no further conversion is required.
SWAPped:	The SMIQ expects (for setting commands) and sends (for queries) first the least significant byte of each IEEE754 floating point number, last the most significant byte.

Example: `:FORMat:BORDer:NORMal` *RST-value is NORMal

3.5.8 MEMory System

This system contains the commands for the memory management of the SMIQ.

Command	Parameter	Default Unit	Remark
:MEMory :NSTates?			Query only

:MEMory:NSTates?

The command returns the number of *SAV/*RCL memories available. The SMIQ has 50 *SAV/*RCL memories in total.

Example: `:MEM:NST?` Response: `50`

3.5.9 OUTPut-System

This system contains the commands specifying the characteristics of the RF output socket and the BLANk socket. The characteristics of the LF socket are specified in the OUTPut2 system.

Command	Parameter	Default Unit	Remark
:OUTPut			
:AMODe	AUTO I FIXed I ELECtronic		
:AFIXed			
:RANGe			
:UPPer?			Query only
:LOWer?			Query only
:BLANk			
:POLarity	NORMal I INVerted		
:IMPedance?			Query only
:PROTection			
:CLEar			
:TRIPped?			Query only
[:STATe]	ON I OFF		
:PON	OFF I UNChanged		

:OUTPut:AMODe AUTO I FIXed I ELECtronic

The command switches over the operating mode of the attenuator at the RF output (Attenuator MODe).

AUTO	The attenuator is switched whenever possible.
FIXed	The attenuator is switched when certain fixed levels are exceeded/fallen below.
ELECtronic	The level is additionally (without modifying the attenuator) changed via the IQ modulator.

Example: `:OUTP:AMOD AUTO` *RST value is AUTO

:OUTPut:AFIXed:RANGe:UPPer?

This command queries the maximum level which can be set without modifying the attenuator (Attenuator FIXed).

Example: `:OUTP:AFIX:RANG:UPP?` Response: -27

:OUTPut:AFIXed:RANGe:LOWer?

This command queries the minimum level which can be set without modifying the attenuator (Attenuator FIXed).

Example: `:OUTP:AFIX:RANG:UPP?` Response: `-50`

:OUTPut:BLANk:POLarity NORMal I INVerted

The command sets the polarity of the BLANk signal.

NORMal	The active BLANk state is indicated by the more positive or higher output voltage.
INVers	The active BLANk state is indicated by the more negative or lower output voltage.

Example: `:OUTP:BLAN:POL NORM` RST value is NORM

:OUTPut:IMPedance?

The command queries the impedance of the RF output. This permits converting the output level between units V and W. The impedances cannot be changed. With the SMIQ, this is the fixed value of 50 Ohm for the RF output.

Example: `:OUTP:IMP?` Response: `50`

:OUTPut:PROTection

The commands to configure the protective circuit are under this node. The RF output is protected by a protective circuit which deactivates the output if an overvoltage is supplied from outside. This does not change the value of `OUTPut:STATe`.

:OUTPut:PROTection:CLEar

The command resets the protective circuit after it has been triggered. The state of the output is determined by `OUTPut:STATe` again. The command triggers an event and hence has no default setting value.

Example: `:OUTP:PROT:CLE`

:OUTPut:PROTection:TRIPped?

The command queries the state of the protective circuit. The responses mean:

"0"	The protective circuit has not responded
"1"	The protective circuit has responded

Example: `:OUTP:PROT:TRIP?` Response: `"1"`

:OUTPut[:STATe] ON I OFF

The command switches on or off the RF output. The RF output can also be switched off by the response of the protective circuit. But this has no influence on this parameter.

Note: *In contrast to the PRESET key, command *RST sets this value to OFF, the output is deactivated.*

Example: `:OUTP:STAT ON` *RST value is OFF

:OUTPut[:STATe]:PON OFF I UNCHanged

This command selects the state the RF output is to assume after power-on of the unit. It only exists for the RF output. *RST does not influence the set value.

OFF	Output is switched off.
UNCHanged	Same state as before switch- off

Example: `:OUTP:PON OFF`

3.5.10 OUTPut2 System

This system contains the commands specifying the characteristics of the LF output socket.

Command	Parameter	Default Unit	Remark
:OUTPut2			
[:STATe]	ON | OFF		
:VOLTage	0 V to 4 V	V	

:OUTPut2[:STATe] ON | OFF

The command switches the LF output on or off. *RST value is OFF

Example: `:OUTP2:STAT ON`

:OUTPut2:VOLTage 0V to 4V

The command sets the voltage of the LF output.

Example: `:OUTP2:VOLT 3.0V` *RST value is 1 V

3.5.11 SOURce-System

This system contains the commands to configure the RF signal source. Keyword SOURce is optional, i.e., it can be omitted. The LF signal source is configured in the SOURce2 system.

The following subsystems are realized in the instrument:

Subsystem	Settings
[:SOURce]	
:AM	Amplitude modulation
:CORRection	Correction of the output level
:DECT	Digital standard DECT
:DIST	Distortion simulation
:DM	I/Q and digital standard modulations
:FM	Frequency modulation
:FREQuency	Frequencies including sweep
:FSIM	Fading simulator
:GSM	Digital standard GSM
:IS95	Digital standard IS-95 CDMA
:LIST	LIST mode
:MARKer	Marker generation with sweeps
:NADC	Digital standard NADC
:NOISe	Noise generation
:PDC	Digital standard PDC
:PHASe	Phase between output signal and reference oscillator signal
:PHS	Digital standard PHS
:PM	Phase modulation
:POWer	Output level, level control and level correction
:PULM	Pulse modulation
:ROSCillator	Reference oscillator
:SWEep	Sweeps
:WCDMa	Digital standard W-CDMA
:W3GPp	Digital standard 3GPP W-CDMA

3.5.11.1 SOURce:AM Subsystem

This subsystem contains the commands to control the amplitude modulation. Part if the LF-generator settings is effected under SOURce2.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:AM			
:BBANd			
[:STATe]	ON I OFF		
[:DEPTh]	0 to 100 PCT	PCT	
:EXTernal			
:COUPling	AC I DC		
:INTernal1I2			
:FREQuency	0.1 Hz to 1 MHz	Hz	
:SOURce	EXT I INT I EXT, INT		
:STATe	ON I OFF		

[:SOURce]:AM:BBANd[:STATe] ON I OFF

The command switches on or off the BB-AM (through the I-input of the IQ-modulator).

Example: `:SOUR:AM:BBAN:STAT ON` *RST value is OFF

[:SOURce]:AM[:DEPTh] 0 to 100PCT

The command sets the modulation depth in percent.

Example: `:SOUR:AM:DEPT 15PCT` *RST value is 30PCT

[:SOURce]:AM:EXTernal:COUPling AC I DC

The command selects the type of coupling for the external AM input.

AC The d.c. voltage content is separated from the modulation signal.

DC The modulation signal is not altered.

Example: `:SOUR:AM:EXT:COUP AC` *RST value is AC

[:SOURce]:AM:INTernal

The settings for the internal AM inputs (LF generator) are effected under this node.

Here the same hardware is set for AM, PM, FM and SOURce2. This means that, for example, the following commands are coupled with each other and have the same effect:

```
:SOUR:FM:INT:FREQ;
:SOUR:PM:INT:FREQ;
:SOUR2:FREQ:CW
```

[:SOURce]:AM:INTernal1|2:FREQuency 0.1 Hz to 1MHz

The command sets the modulation frequency.

Example: `:SOUR:AM:INT:FREQ 15kHz` *RST value is 1 kHz

[:SOURce]:AM:SOURce EXT | INT|EXT, INT

The command selects the modulation source. INT is the internal LF generator. The external and the internal modulation source can be indicated at the same time (see example).

Example: `:SOUR:AM:SOUR INT,EXT` *RST value is INT

[:SOURce]:AM:STATe ON | OFF

The command switches amplitude modulation on or off.

Example: `:SOUR:AM:STAT ON` *RST value is OFF

3.5.11.2 SOURce:CORRection Subsystem

The CORRection subsystem permits a correction of the output level. The correction is effected by adding user-defined table values to the output level as a function of the RF frequency. In the SMIQ, this subsystem serves to select, transmit and switch on USER-CORRECTION tables (see Chapter 2, Section "User Correction (UCOR)" as well).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:CORRection			
[:STATe]	ON | OFF		
:CSET			
:CATalog?			Query only
[:SELect]	"Name of table"		
:DATA			
:FREQuency	300 kHz to RF$_{max}$ {,300 kHz to RF$_{max}$ }	Hz	RF$_{max}$ depending on model
:POWer	-40 dBto 6dB {,-40 dBto 6dB}	dB	
:DELete	"Name of table"		no query

[:SOURce]:CORRection[:STATe] ON | OFF

The command switches the table selected using `SOURce:CORRection:CSET` on or off.

Example: `:SOUR:CORR:STAT ON` *RST value is OFF

[:SOURce]:CORRection:CSET

The commands to select and edit the UCOR tables are under this node.

[:SOURce]:CORRection:CSET:CATalog?

The command requests a list of UCOR tables. The individual lists are separated by means of commas. This command is a query and has no *RST value.

Example: `:SOUR:CORR:CAT?` Answer: `"UCOR1", "UCOR2", "UCOR3"`

[:SOURce]:CORRection:CSET[:SELect] "Name of table"

The command selects a UCOR table. This command alone does not yet effect a correction. First the table selected must be activated (cf. `:SOURce:CORRection:STATe`). If there is no table of this name, a new table is created. The name may contain up to 7 letters. This command triggers an event and hence has no *RST value.

Example: `:SOUR:CORR:CSET:SEL "UCOR1"`

[:SOURce]:CORRection:CSET:DATA

The commands to edit the UCOR tables are under this node.

[:SOURce]:CORRection:CSET:DATA:FREQuency 300 kHz to RF_{max} {,300 kHz to RF_{max} }
(RF_{max} depending on model)

The command transmits the frequency data for the table selected using `:SOURce:CORRection:CSET`. *RST does not influence data lists.

Example: `:SOUR:CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz,to`

[:SOURce]:CORRection:CSET:DATA:POWer -40dB to 6dB {,-40dB to 6dB}

The command transmits the level data for the table selected using `:SOURce:CORRection:CSET`. *RST does not influence data lists.

Example: `:SOUR:CORR:CSET:DATA:POWer 1dB, 0.8dB, 0.75dB,to`

[:SOURce]:CORRection:CSET:DELete "Name of table"

The command deletes the table indicated from the instrument memory. This command triggers an event and hence has no *RST value.

Example: `:SOUR:CORR:CSET:DEL "UCOR2"`

3.5.11.3 SOURce:DECT-Subsystem (Digital Standard)

Note *#B0 to #BF are characters which are entered in binary form manually. SCPI (and IEEE 488.2) also accept the entry of non-decimal characters in octal and hexadecimal such as*
#H|h <0 to 9, A|a to F|f>,
#Q|q <0 to 7> and
#B|b <0|1>.
The characters are always output in Hex format after a query.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:DECT			
:STATe	ON | OFF		
:STANdard			
:FORMat	GFSK | P4DQpsk		
:FSK			
:DEViation	100Hz to 1.2MHz	HZ	range 0.1 to 1 × symbol rate
:SRATe	2k to 1.2M / 1k to 0.6M Hz (GFSK/P4DQ)	Hz	
:FILTer			
:TYPE	GAUSs | SCOSine| COSine		
:PARameter	0.2 to 0.7		
:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger		
:TRIGger			
:SOURce	EXTernal | INTernal		
:INHibit	0 to 67.1E6		
:DELay	0 to 65535		
:OUTPut[2]			
:DELay	0 to 11519		
:PERiod	1 to 67.1E6		
:CLOCk			
:SOURce	INTernal | EXTernal		
:DELay	0 to 1.0		
:PRAMp			
:PRESet			no query
:TIME	0.25 to 16		
:DELay	-1.0 to +1.0		
:SHAPe	LINear | COSine		
:ROFFset	-9 to +9		
:FOFFset	-9 to +9		
:SLOT			
:ATTenuation	0 to 70 dB	dB	

Command	Parameter	Default Unit	Remark
[:SOURce]			
:DECT			
:SIMulation			
:TADJustment	-4 to +4 (symbol)		
:JITTer	0 to 4 (symbol)		
:FLISt			
:PREDefined			
:CATalog?	'name'		query only
:LOAD	'name'		no query
:CATalog?	'name'		query only
:LOAD	'name'		no query
:STORe	'name'		no query
:DELete	'name'		no query
:DLISt			
:CATalog?	'name'		query only
:PREamble			
:TYPE	NORMal | PROLonged		
:SLOT<i>			i=0,[1],..23 (Slot Selector)
:TYPE	FULL | DOUBle | ADATa		
:LEVel	OFF | ATT | FULL		
:PRESet			no query
:STSHift	-9 to +9	(Bit)	
:RAMP			
:CW	ON | OFF		
:DATA	#B0 to #B111111111111 (12 Bit)		
:PREamble			
:DATA	#B0 to #B1111111111111111 (16 Bit)		
:PROLonged			
:DATA	#B0 to #B1111111111111111... (32 Bit)		
:SYNC	#B0 to #B1111111111111111 (16 Bit)		
[:SOURce]			
:AFIeld	PN9 | PN11| PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:BFIeld	PN9 | PN11| PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:ZFIeld	ON | OFF'		

[:SOURce]:DECT:STATe ON | OFF

The command switches the modulation on according to DECT standard. All other standards that might be switched on or digital modulation are automatically switched OFF.

Example: `:SOUR:DECT:STAT ON` *RST value is OFF

[:SOURce]:DECT:STANdard

The command sets all modulation parameters to the values of the DECT standard. It does not set the parameters selected with the `:DECT:SLOT...` commands described in the following. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DECT:STAN`

[:SOURce]:DECT:FORMat GFSK | P4DQpsk

The command selects the type of modulation.

Example: `:SOUR:DECT:FORM P4DQ` *RST value is GFSK

[:SOURce]:DECT:FSK:DEViation 1kHz to 1.2 MHz

The command sets the modulation depth (only for `DECT:FORMat GFSK`). The range of values depends on the symbol rate (`DECT:SRATe` × 0.1 to 1).

Example: `:SOUR:DECT:FSK:DEV 300.6kHz` *RST value is 288kHz

[:SOURce]:DECT:SRATe 1kHz to 1.2 MHz

The command sets the symbol rate. Permissible values for `GFSK` are 2 kHz to 1.2 MHz and 1 kHz to 0.6 MHz for `P4QPsk`.

Example: `:SOUR:DECT:SRAT 192.1 kHz` *RST value is 1152/576kHz (GFSK/P4DQ)

[:SOURce]:DECT:FILTer

The commands for selecting a filter are under this node.

[:SOURce]:DECT:FILTer:TYPE GAUSs | SCOSine | COSine

The command selects the type of filter; `SCOS` and `COS` can be set for `P4DQpsk`. For `DECT:FORMat GFSK`, the `GAUSs` type is set automatically.

Example: `:SOUR:DECT:FILT:TYPE COS` *RST value is GAUS/SCOS (GFSK/P4DQ)

[:SOURce]:DECT:FILTer:PARameter 0.2 to 0.7

The command sets the filter parameter.

Example: `:SOUR:DECT:FILT:PAR 0.2` *RST value is 0. 5

[:SOURce]:DECT:SEQuence AUTO | RETRigger | AAUTo | ARETrigger

The command selects the trigger mode for the sequence.

AAUTo	ARMED AUTO
ARETrigger	ARMED RETRIG

Example: `:SOUR:DECT:SEQ AAUT` *RST value is AUTO

[:SOURce]:DECT:TRIGger:SOURce EXTernal | INTernal

The command selects the trigger source. With INT selected, triggering is via IEC/IEEE bus or the Execute command in manual control.

Example: `:SOUR:DECT:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:DECT:TRIGger:INHibit 0 to 67.1E6

The command sets the retrigger inhibit duration (in number of symbols).

Example: `:SOUR:DECT:TRIG:INH 1000` *RST value is 0

[:SOURce]:DECT:TRIGger:DELay 0 to 65535

The command sets the trigger delay (in number of symbols).

Example: `:SOUR:DECT:TRIG:DEL 200` *RST value is 0

[:SOURce]:DECT:TRIGger:OUTPut[2]:DELay 0 to 11519

The command determines the delay of the signal at trigger output 2 in comparison with the start of the frames in number of symbols.

Example: `:SOUR:DECT:TRIG:OUTP2:DEL 16` *RST value is 0

[:SOURce]:DECT:TRIGger:OUTPut[2]:PERiod 1 to 67.1E6

The command sets the repeat rate (in number of frames) of the signal at trigger output 2.

Example: `:SOUR:DECT:TRIG:OUTP:PER 8` *RST value is 1

[:SOURce]:DECT:CLOCk

The commands for setting the data clock are under this node.

[:SOURce]:DECT:CLOCk:SOURce INTernal | EXTernal

The command selects the source for the DM data clock.

INTernal	The internal clock generator is used and output via the clock outputs of the serial and parallel interface.
EXTernal	The clock is externally fed in via the serial interface and output via the parallel interface.

Example: `:SOUR:DECT:CLOC:SOUR INT` *RST value is INT

[:SOURce]:DECT:CLOCk:DELay 0 to 1.0

The command sets the delay of the symbol clock (as a fraction of the length of a symbol).

Example: `:SOUR:DECT:CLOC:DEL 0.75` *RST value is 0

[:SOURce]:DECT:PRAMp

The commands for the level control of the burst are under this node.

[:SOURce]:DECT:PRAMp:PRESet

This command sets the standard-stipulated values for the following commands of level control. It is an event and hence has no query and no *RST value.

Example: `:SOUR:DECT:PRAM:PRES`

[:SOURce]:DECT:PRAMp:TIME 0.25 to 16.0

The command sets the cutoff steepness (in symbol clocks).

Example: `:SOUR:DECT:PRAM:TIME 2.5` *RST value is 2

[:SOURce]:DECT:PRAMp:DELay -1.0 to +1.0

he command defines the shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope.

Example: `:SOUR:DECT:PRAM:DEL 0.2` *RST value is 0

[:SOURce]:DECT:PRAMp:SHAPe LINear | COSine

The command selects the linear or cosine shape of the ramp-up and ramp-down (power burst).

Example: `:SOUR:DECT:PRAM:SHAP LIN` *RST value is COS

[:SOURce]:DECT:PRAMp:ROFFset -9 to +9

The command determines the timing of the ('R'ising) edge of a power burst to the beginning of the slot.

Example: `:SOUR:DECT:PRAM:ROFF -3` *RST value is 0

[:SOURce]:DECT:PRAMp:FOFFset -9 to +9

The command determines the timing of the ('F'alling) edge of a power burst to the data block.

Example: `:SOUR:DECT:PRAM:FOFF 4` *RST value is 0

[:SOURce]:DECT:SLOT:ATTenuation 0 to 70 dB

The command determines the amount by which the power of the slots marked by `:DECT:SLOT:LEVEL ATT` is reduced in comparison with the normal output power (attribut to `:LEVEL FULL`).

Example: `:SOUR:DECT:SLOT:ATT 20 dB` *RST value is 0

[:SOURce]:DECT:SIMulation:TADJustment -4 to +4 (in symbols)

This command simulates the timing adjust by extending every 35th frame by the set number of symbols (positive) or by reducing it (negative). 0 is off.

Example: `:SOUR:DECT:SIM:TADJ 3` *RST value is 0

[:SOURce]:DECT:SIMulation:JITTer 0 to 4 (in symbols)

This command simulates the jitter by advancing even frames by the set number of symbols and by delaying uneven frames. 0 is off.

Example: `:SOUR:DECT:SIM:JITT 2` *RST value is 0

[:SOURce]:DECT:FLISt

The commands for storing and reading complete frames including their bursts (slots) are under this node. Predefined and user-generated frames have to be distinguished.

[:SOURce]:DECT:FLISt:PREDefined:CATalog?

The command returns a list of all predefined frames.

Example: `:SOUR:DECT:FLIS:PRED:CAT?`

[:SOURce]:DECT:FLISt:PREDefined:LOAD 'name'

The command selects one of the predefined (fixed) frames (c.f. Chapter 2). This command triggers an event and hence has no *RST value.

Example: `:SOUR:DECT:FLIS:PRED:LOAD 'test'`

[:SOURce]:DECT:FLISt:CATalog?

The command returns a list of all user-defined frames.

Example: `:SOUR:DECT:FLIS:CAT?`

[:SOURce]:DECT:FLISt:LOAD 'name'

The command loads a user-defined frame. This command triggers an event and hence has no *RST value.

Example: `:SOUR:DECT:FLIS:LOAD 'test'`

[:SOURce]:DECT:FLISt:STORe 'name'

The command stores the current frame under a name. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DECT:FLIS:STOR 'test'`

[:SOURce]:DECT:FLISt:DELete 'name'

The command deletes the indicated frame. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DECT:FLIS:DEL 'test1'`

[:SOURce]:DECT:DLISt:CATalog?

The command returns an enumeration of all data lists.

These data lists are selected by means of `:DECT:SLOT:AFI:DLIS 'name'` and. `...:BFI:DLIS 'name'` and used if `:DECT:SLOT:AFI DLISt` and `...: :BFI DLIS` are set.

Example: `:SOUR:DECT:DLIS:CAT?`

[:SOURce]:DECT:PREamble:TYPE NORMal | PROLonged

The command selects the 16-bit (NORMal) or 32-bit (PROLonged) preamble.

Example: `:SOUR:DECT:PRE PROL PRO` *RST value is NORM

[:SOURce]:DECT:SLOT<i>

The commands for setting the slot characteristics are under this node. Since a frame contains 24 slots, suffix 'i' is used to select the slot to be changed. i = [1] | 2 to | 22 | 23. Slot 0 to 11 can be used for downlink and slot 12 to 23 for uplink. For double slot even numbers can be entered only since it occupies two full slots.

[:SOURce]:DECT:SLOT<i>:TYPE FULL | DOUBle | ADATa

The command selects the type of burst (slot) defined in the standard.

ADATa is All Data; the data source set with `SLOT<i>:BFIeld` is used.

Example: `:SOUR:DECT:SLOT2:TYPE ADAT` *RST value is FULL

[:SOURce]:DECT:SLOT<i>:LEVel OFF | ATT | FULL

The command determines the power stage of the slot.

OFF	The slot is inactive
ATT	The power is reduced by the amount defined by `:DECT:SLOT:ATT`
FULL	Full power (predefined by level setting).

Example: `:SOUR:DECT:SLOT2:LEV ATT` *RST value is FULL

[:SOURce]:DECT:SLOT<i>:PRESet

The command sets all the following parameters of the slot to the values defined by the standard as a function of the type set above. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DECT:SLOT2:PRES`

[:SOURce]:DECT:SLOT<i>:STSHift -9 to +9 (in bit)

This command allows a timing shift of the indicated slot by the set number of bits to simulate a wrong timing (positive = delay; negative = advance).

Example: `:SOUR:DECT:SLOT2:STSH -3` *RST value is 0

[:SOURce]:DECT:SLOT<i>:RAMP:CW ON | OFF

The command activates or deactivates the generation of unmodulated (CW) signal during the ramp time.

Example: `:SOUR:DECT:SLOT2:PRAM:CW ON` *RST value is OFF

[:SOURce]:DECT:SLOT<i>:RAMP:DATA #B0 to #B111 to (12bit)

The command sets the data used during the ramp time.

Example: `:SOUR:DECT:SLOT2:PRAM:DATA #B111100001111`

*RST value is 101010101010 / 010101010101 (downl./uplink)

[:SOURce]:DECT:SLOT<i>:PREamble:DATA #B0 to #B111 to (16bit)

The command sets the data used for the 16-bit long preamble.

Example: `:SOUR:DECT:SLOT2:PRE:DATA #B1111000011110000`

*RST value is 1010101010101010 / 0101010101010101 (downlink/uplink)

[:SOURce]:DECT:SLOT<i>:PREamble:PROLonged:DATA #B0 to #B111 to (32bit)

The command sets the data used for the 32-bit long preamble.

Example: `:SOUR:DECT:SLOT2:PRE:PROL:DATA #B1111`

*RST value 10101010101010101010101010101010 (downlink)
*RST value 01010101010101010101010101010101 (uplink)

[:SOURce]:DECT:SLOT<i>:SYNC #B0 to #B111 to (16bit)

The command sets the data used for synchronization.

Example: `:SOUR:DECT:SLOT2:SYNC #B0000111100001111`

RST value is 1110100110001010 / 0001011001110101 (downl./uplink)

[:SOURce]:DECT:SLOT<i>[:SOURce]:AFIeld PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command defines the data source for the A field. It is either a PRBS generator (of different sequence length), a data list or the serial interface.

Example: `:SOUR:DECT:SLOT3:AFI PN15` *RST value is PN9

[:SOURce]:DECT:SLOT<i>[:SOURce]:AFIeld:DLISt 'name'

The command selects a data list. This list is used only if lists have been set as data source using the command `:DECT:SLOT:AFI DLIS`. This command triggers an event and hence has no *RST value.

Example: `:DECT:SLOT:AFI:DLIS 'test'`

[:SOURce]:DECT:SLOT<i>[:SOURce]:BFIeld PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the B field. The data source set by means of this command is also used for `SLOT:TYPE ADATa`. It is either a PRBS generator (of different sequence length), a data list or the serial interface.

Example: `:SOUR:DECT:SLOT3:BFI PN15` *RST value is PN9

[:SOURce]:DECT:SLOT<i>[:SOURce]:BFIeld:DLISt 'name'

The command selects a data list. This list is used only if lists have been set as data source using the command `:DECT:SLOT:BFI DLIS`. This command triggers an event and hence has no *RST value.

Example: `:DECT:SLOT:BFI:DLIS 'test'`

[:SOURce]:DECT:SLOT<i>[:SOURce]:ZFIeld ON | OFF

The command activates/deactivates the repetition of the content of the X field.

Example: `:SOUR:DECT:SLOT2:ZFI ON` *RST value is ON

3.5.11.4 SOURce:DIST Subsystem

Subsystem DISTortion comprises all commands for setting the distortion simulator.
The NDSim subsystem under CALibrate is available for the offset calibration.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:DISTortion			Not-SCPI
[:STATe]	ON I OFF		
:MODE	POLYnomial I DATA		
:DATA			
:CATalog?			Query only
:SELect	'name of characteristic'		
:DELete	'name of characteristic'		
:ALL			
:AM	-100 dB to 0 dB {, -100 dB to 0 dB } I block data	dB	
:FREE?			Query only
:POINts?			Query only
:AMBase	-100 dB to 0 dB {, -100 dB to 0 dB } I block data	-	
:POINts?			Query only
:PM	-180 degrees to +180 degrees {, -180 degrees to +180 degrees} I block data	dB	
:FREE?			Query only
:POINts?			Query only
:PMBase	-100 dB to 0 dB {, -100 dB to 0 dB } I block data	-	
:POINts?			Query only
:LEVel			
:CORRection	-20.0 to 6.00	dB	
:POLYnomial			Not-SCPI
:AMAM			
:K<i>	-10 dB to +10 dB	dB	
:AMPM			
:K<i>	-60 deg to +60 deg		
:IFUNction	ON I OFF		
:LEVel			
:CORRection	-20 dB to +6 dB	dB	
:RECalculate			

[:SOURce]:DISTortion[:STATe] ON I OFF

This command switches the distortion function on or off.

Example: `:SOUR:DIST ON` *RST value is OFF

[:SOURce]:DISTortion:MODE POLYnomial I DATA

Distortion data are calculated either by a list (`:DIST:DATA`... commands) or from the coefficients of a polynomial (`:DIST:POLY`... commands).

Example: `:SOUR:DIST POLY` *RST value is DATA

[:SOURce]:DISTortion:DATA

The commands for the characteristics are under this node.

[:SOURce]:DISTortion:DATA:CATalog?

This command outputs a list with the names of all characteristics stored in the unit separated by commas. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:CAT?` Answer eg: TWTA, USER, ...

[:SOURce]:DISTortion:DATA:SELect '<name of characteristic>'

This command selects the characteristic (data list) all other `SOURCE:DIST:DATA:...` commands refer to. If a new characteristic is to be generated, the name (max. 8 characters) can be entered here. A new characteristic is then created under this name. Up to 10 characteristics can be created. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:SEL "TWTA"`

[:SOURce]:DISTortion:DATA:DELete '<name of characteristic>'

This command deletes the indicated characteristic. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:DEL "TEST1"`

[:SOURce]:DISTortion:DATA:DELete:ALL

This command deletes all characteristics. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:DEL:ALL`

[:SOURce]:DISTortion:DATA:AM -100 dB to 0 dB {, -100 dB to 0 dB } | block data

This command fills the output values (y-axis) for the AM/AM conversion of the selected characteristic with data. The data can be transmitted as a list of any length separated by commas or as a binary block. If they are transmitted as block data, 8 (4) bytes are interpreted as floating-point value with double accuracy; settable with command `FORMAT:DATA`. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:AM -12.6,-7.8,-5.2,-4.4,-3.6,-3,-2.4,...`

[:SOURce]:DISTortion:DATA:AM:FREE?

This command outputs two values. One indicates the remaining storage capacity for new AM/AM characteristics and the other provides information about the space which is already occupied. All indications refer to the number of elements. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:AM:FREE?` Answer eg: 30,0

[:SOURce]:DISTortion:DATA:AM:POINts?

The command provides the length of the output-value list (y-axis) of AM/AM conversion in elements. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:AM:POINts?` Answer eg: 0

[:SOURce]:DISTortion:DATA:AMBase -100 dB to 0 dB {, -100 dB to 0 dB } | block data

This command fills the input values (x-axis) for the AM/AM conversion of the selected characteristic with data. The data can be transmitted as a list of any length separated by commas or as a binary block. If they are transmitted as block data, 8 (4) bytes are interpreted as floating-point value with double accuracy; settable with `FORM:DATA`. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:AMB -23.5,-18.5,-15.5,-14.5,-13.5,...`

[:SOURce]:DISTortion:DATA:AMBase:POINts?

This command provides the length of the input-value list (x-axis) of AM/AM conversion in elements. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:AMB:POINts?` Answer eg: 0

[:SOURce]:DISTortion:DATA:PM -180 degrees to +180 degrees {, -180 degrees to +180 degrees } | block data

This command fills the output values (y-axis) for the AM/PM conversion of the selected characteristic with data. The data can be transmitted as a list of any length separated by commas or as a binary block. If they are transmitted as block data, 8 (4) bytes are interpreted as floating-point value with double accuracy; settable with command `FORMAT:DATA`. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:PM 0,-1.2,-3.8,-9.5,-15.9,-23,-30.4,-43.4`

[:SOURce]:DISTortion:DATA:PM:FREE?

This command outputs two values. One indicates the remaining storage capacity for new AM/PM characteristics and the other provides information about the space which is already occupied. All indications refer to the number of elements. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:PM:FREE?` Answer eg: 30, 0

[:SOURce]:DISTortion:DATA:PM:POINts?

The command provides the length of the output-value list (y-axis) of AM/PM conversion in elements. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:PM:POINts?"` Answer eg: 0

[:SOURce]:DISTortion:DATA:PMBase -100 dB to 0 dB {, -100 dB to 0 dB } | block data

This command fills the input values (x-axis) for the AM/PM conversion of the selected characteristic with data. The data can be transmitted as a list of any length separated by commas or as a binary block. If they are transmitted as block data, 8 bytes are interpreted as floating-point value; settable with command `FORMAT:DATA`. *RST does not influence data lists.

Example: `:SOUR:DIST:DATA:PMB -23.5,-18.5,-15.5,-12.5,-9.5,-6.5,...`

[:SOURce]:DISTortion:DATA:PMBase:POINts?

The command provides the length of the input-value list (x-axis) of AM/PM conversion in elements. The command is a query and hence has no *RST value.

Example: `:SOUR:DIST:DATA:PMB:POINts?"` Answer eg: 0

[:SOURce]:DISTortion:DATA:LEVel:CORRection -20 to +6.00 dB

This command serves for setting the level correction for a particular characteristic.

Example: `:SOUR:DIST:DATA:LEV:CORR -3.12 dB` *RST value is 0 dB

[:SOURce]:DISTortion:POLYnomial:AMAM:K<i> -10 dB to +10 dB

The command sets the coefficients k2 to k5 for the AM-AM distortion.

Example: `:SOUR:DIST:POLY:AMAM:K3 3.4 dB` *RST value is 0 dB

[:SOURce]:DISTortion:POLYnomial:AMPM:K<i> -60 deg to +60 deg

The command sets the coefficients k2 to k5 for the AM-PM distortion.

Example: `:SOUR:DIST:POLY:AMPM:K4 12.8 deg` *RST value is 0 deg

[:SOURce]:DISTortion:POLYnomial:IFUNction ON I OFF

The command switches on and off the inversion of the distortion characteristic to compensate an amplifier connected after the SMIQ.

Example: `:SOUR:DIST:POLY:IFUN ON` *RST value is OFF

[:SOURce]:DISTortion:POLYnomial:LEVel:CORRection -20 dB to +6 dB

The command sets the level correction for the distortion characteristic from the polynomial coefficients.

Example: `:SOUR:DIST:DATA:LEV:CORR -3.12 DB` *RST value is 0 dB

[:SOURce]:DISTortion:RECalculate

The distortion data transmitted to the unit via IEC/IEEE bus are loaded in the module and become active. This command triggers an action and therefore has no *RST value.

Example: `:SOUR:DIST:REC`

3.5.11.5 SOURce:DM Subsystem

In this subsystem, the types of digital standard modulation as well as vector modulation (I/Q modulation) are checked.

Vector Modulation

Command	Parameter	Default Unit	Remark
[:SOURce]			
:DM			
:IQ			
:STATe	ON I OFF		
:PRAMp	OFF I AEXTernal		
:IMPairment			
[:STATe]	ON I OFF		
:LEAKage			
[:MAGNitude]	0 to 50.0 PCT	PCT	
:FILTer			Only with option SMIQB47
:STATe	ON I OFF		
:FREQuency	850 kHz I 2.5 MHz I 5 MHz	Hz	
:QUADrature			
:ANGLe	-10.0 to 10.0 DEG	DEG	
:IQRatio			
[:MAGNitude]	-12.0 to 12.0 PCT	PCT	
:IQSWap			
[:STATe]	ON I OFF		

[:SOURce]:DM:IQ:STATe ON I OFF

This command switches vector modulation (I/Q modulation) on or off.

Example: `:SOUR:DM:IQ:STAT ON` *RST value: OFF

[:SOURce]:DM:IQ:PRAMp OFF I AEXTernal

This command switches the level control via the input socket (analog external).

Example: `:SOUR:DM:IQ:PRAM AEXT` *RST value: OFF

[:SOURce]:DM:IQ:IMPairment[:STATe] ON I OFF

This command activates (ON) or deactivates (OFF) the three tuning or correction values LEAKage, QUADrature and IQRatio for I/Q modulation.

Example: `:SOUR:DM:IQ:IMP OFF` *RST value: OFF

[:SOURce]:DM:LEAKage[:MAGNitude] 0 to 50.0 PCT

This command adjusts the residual carrier amplitude for I/Q modulation.

Example: `:SOUR:DM:LEAK 3PCT` *RST value: 0

[:SOURce]:DM:IQ:FILTer

The commands for the IQ filter settings are under this node.

[:SOURce]:DM:IQ:FILTer:STATe ON | OFF

This command switches the IQ filter ON or OFF. It is only available with option SMIQB47 - LOW ACP Filter.

Example: `:SOUR:DM:IQ:FILT:STAT ON` *RST value: OFF

[:SOURce]:DM:IQ:FILTer:FREQuency 850 kHz, 2.5 MHz, 5 MHz

This command selects an IQ filter with the limit frequencies 850 kHz, 2.5 MHz or 5 MHz. It is only available with option SMIQB47 - LOW ACP Filter.

Example: `:SOUR:DM:IQ:FILT:FREQ 2.5MHZ` *RST value is 2.5 MHz

[:SOURce]:DM:QUADrature:ANGLe -10.0 to 10.0 degree

This command changes the quadrature offset for I/Q modulation.

Example: `:SOUR:DM:QUAD:ANGL -5DEG` *RST value: 0

[:SOURce]:DM:IQRatio[:MAGNitude] -12.0 to 12.0 PCT

This command adjusts the ratio of I and Q modulation (gain imbalance).

Example: `:SOUR:DM:IQR 4PCT` *RST value: 0

[:SOURce]:DM:IQSWap[:STATe] ON | OFF

This command interchanges the I and Q channels in position ON.

Example: `:SOUR:DM:IQSW OFF` *RST value: OFF

Digital Modulation

Command	Parameter	Default unit	Remark
[:SOURce]			
:DM			
:STATe	ON | OFF		
:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger | SINGle		
:SOURce	PRBS | PATTern | DLISt | SERial | PARallel | SDATa		
:PATTern	ZERO | ONE | ALTernate		
:PRBS			
[:LENGth]	9 | 15 | 16 | 20 | 21 | 23		
:DLISt			
:DATA	0 | 1 {,0 | 1 } or block data		
:DATA?	[<start>[,<length>]]		query
:APPend	0 < 1 {,0 | 1} or block data		no query
:CATalog?			query only
:SELect	'name'		
:DELete	'name'		no query
:COPY	'name'		no query
:FREE?			query only
:POINts	<n>		
:CLISt			
:CONTrol			
[:STATe]	ON | OFF		
:DATA	<struc> {, <struc>}...		
:CATalog?			query only
:SELect	'name'		
:DELete	'name'		no query
:COPY	'name'		no query
:FREE?			query only
:POINts?			query only
:MLISt			
:DATA	A,B,C,D,E,F, I1, Q1, I2, Q2...		
:CATalog?			query only
:SELect	'name'		
:DELete	'name'		no query
:FREE?			query only
:POINts?			query only

Command	Parameter	Default unit	Remark
[:SOURce]			
:DM			
:STANdard	APCFm I APCQpsk I CDPD I CT2 I DECT I GSM I GSMEdge I IRIDium I FIS95 I RIS95 I NADC I PDC I PHS I TETRa I TFTS I PWT I QWCDma I ICOBpsk I ICOGmsk I ICOQpsk I WORLdspace I AT55		QWCDma only with option SMIQB47 WORLDspace only with option SMIQB17
:FORMat	GMSK I GFSK I BPSK I QPSK I QIS95 I QICO I QWCDma I QINMarsat I OQPSk I OIS95 I P4QPsk I P4DQpsk I PSK8 I PSKE8 I QAM16 to 256 I ASK I FSK2 I FSK4 I AFSK4 I USER		QWCDma only with option SMIQB47
:MDELay?			Query only
:FSK			
:DEViation	100 Hz to 2.5 MHz	Hz	
:SRATe	1kHz to 7 MHz	Hz	
:FILTer			
:TYPE	SCOSine I COSine I GAUSs I LGAUss I BESS1 I BESS2 I IS95 I EIS95 I APCO I TETRa I WCDMa I RECTangle I SPHase		
:PARameter	0.1 to 1.0		
:MODE	LACP I LEVM		
:CODing	OFFI GSMI NADCI PDCI PHSI TETRaI PWTI TFTSI DIFFI DGRayI DPHSI APCO25I INMarsatI VDL		
:CLOCk			
:SOURce	INTernal I EXTernal I COUPled		
:MODE	BIT I SYMBol		
:DELay	0 to 1.0		
:POLarity	NORMal I INVerted		
:LDIStortion			
[:STATe]	ON I OFF		
:PRAMp			
[:STATe]	ON I OFF		
:SOURce	CLISt I AEXTernal I DEXTernal		
:TIME	0.25 to 32		
:DELay	-1.0 to 5.0		
:SHAPe	LINear I COSine		
:ATTenuation	0 to 70 dB	dB	
:TRIGger			
:SOURce	EXTernal I INTernal		
:INHibit	0 to 67.1E6		
:DELay	0 to 65535		
:SLOPe	POSitive I NEGative		
:THReshold			
[:ALL]	-2,5 to +2,5 V	V	
:INPut			
:IMPedance	G1K I G50 I ECL		

[:SOURce]:DM:STATe ON | OFF

The command switches the digital (user-defined, not stipulated by a standard) modulation on or off.

Example: `:SOUR:DM:STAT ON` *RST value is OFF

[:SOURce]:DM:SEQuence AUTO | RETRigger | AAUTo | ARETrigger | SINGle

This command selects the trigger mode:

AUTO	The sequence is repeated cyclically.
RETRigger	The sequence is repeated cyclically. After the start, the sequence is restarted with each new trigger even before it is completed.
AAUTo	ARMED AUTO. The sequence waits for a trigger signal. After the start, the trigger mode is AUTO and the sequence cann't be triggered anymore.
ARETrigger	ARMED RETRIGGER. The sequence waits for a trigger signal. After the start, the sequence is restarted with each new trigger even before it is completed.
SINGle	After a trigger event, the sequence is only run once.

Example `:SOUR:DM:SEQ:AAUT` *RST value is AUTO

[:SOURce]:DM:SOURce PRBS | PATTern | DLISt | SERial | PARallel | SDATa

The command selects the data source.

PRBS	internally generated pseudo random bit sequences.
PATT	internally generated (fixed) data pattern.
DLISt	internal data generator (only with DGEN).
SERial	external serial interface.
PARallel	external parallel interface.
SDATa	asynchronous serial data input SER DATA.

Example: `:SOUR:DM:SOUR SER` *RST value is PRBS

[:SOURce]:DM:PATTern ZERO | ONE | ALTernate

The command selects the data pattern. The data range is alternately assigned with 0 and 1 by means of ALTernate.

Example: `:SOUR:DM:PATT ALT` *RST value is ZERO

[:SOURce]:DM:PRBS[:LENGth] 9 | 15 | 16 | 20 | 21 | 23.

The command determines the length of the pseudo random sequence according to the following equation:

Length = (2^LENGth) - 1

Example: `:SOUR:DM:PRBS 21` *RST value is 15

[:SOURce]:DM:DLISt

The commands for the data are under this node. Data lists are not affected by *RST.

[:SOURce]:DM:DLISt:DATA 0 | 1 {,0 | 1 }...

This command transmits the bit data to the selected data list which is thus overwritten. The data can also be transmitted as block data in binary or PACKed format (see section: Parameter, Block Data). Each byte will then be interpreted as made up of 8 data bits. Here, the command `:SYSTem:COMMunicate:GPIB:LTERminator` EOI should be used to set the delimiter mode to 'circuit message EOI only' so that an accidental LF within the data sequence is not first identified as a delimiter and thus momentarily interrupts the data transmission. The command `...LTER STANdard` resets the delimiter mode. The data are not modified by *RST.

Example:

```
:SOUR:DM:DLIS:DATA 0,1,1,0,0,0,0,1,0,1,0,1,1,0,0,0,0,0,1,0,1,1,0,1
:SOUR:DM:DLIS:DATA #13aX-
```

[:SOURce]:DM:DLISt:DATA? [<start> [,<length>]]

The command reads out the data list. If the query is enhanced by the two parameters start and length, the list will be read out in smaller parts. Start and length are given in bits.

Without parameters the whole length will always be output from address 1.

The data format is selected by means of the `:FORMat ASCii | PACKed` command. The order of the bytes is stipulated in the IEC/IEEE-bus standard (MSbyte first).

Example: `:SOUR:DM:DLIS:DATA? 2048,1024`

[:SOURce]:DM:DLISt:DATA:APPend 0 | 1 {,0 | 1 }...

The command allows to transmit the partly very long data lists (up to 20 Mbits = 2.5 Mbyte) in smaller parts. They are added to the end of already existing data.

First, the data list values have to be overwritten using the above `DM:DLIS:DATA` command. Further data can then be added using the `DM:DLIS:DATA:APP` commands. The data format is the same for the two commands.

Example:

```
:SOUR:DM:DLIS:DATA:APP 0,1,1,0,0,0,0,0,1,0,1,1,0,1,0,0
:SOUR:DM:DLIS:DATA:APP #12aX
```

[:SOURce]:DM:DLISt:CATalog?

The command returns a list of data list names separated by commas.

Example: `:SOUR:DM:DLIS:CAT?`

[:SOURce]:DM:DLISt:SELect '<name>'

The command selects the indicated data list. This list will only take effect as data source with mode `:DM:SOURce DLISt` selected. The list can only be filled with values if it has been selected beforehand. If the indicated list does not exist, it will be generated. <name> has to be put in brackets (< >) and may have up to 7 characters.

Example: `:SOUR:DM:DLIS:SEL 'test'`

[:SOURce]:DM:DLISt:DELete '<name>'

This command deletes the data list indicated by <name>. The name has to be put in brackets (<>) and may have up to 7 alphanumeric characters. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DM:DLIS:DEL 'test1'`

[:SOURce]:DM:DLISt:COPY '<name>'

The command copies the selected list to the data list indicated by <name>. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DM:DLIS:COPY 'test1'`

[:SOURce]:DM:DLISt:FREE?

This command returns the available free space for digital data (in bits) and the length of the selected list. The 2 values are separated by a comma.

Example: `:SOUR:DM:DLIS:FREE?`

[:SOURce]:DM:DLISt:POINts <n>

The command indicates the number of elements (in bits) of the currently selected data list. Since only multiples of 8 bits can be transmitted when using block data, the exact number of used bits can be set here. Overflow bits in the list are ignored.

Example: `:SOUR:DM:DLIS:POIN 234`

[:SOURce]:DM:CLISt

The commands for processing the control list are under this node. The control list contains the switching signals for the burst, the level, the modulation etc. The list index is with reference to the symbols in the data list and the list only contains the status changes. Control lists are not affected by *RST.

[:SOURce]:DM:CLISt:CONTrol[:STATe] ON | OFF

The command switches control on or off using the control list.

Example: `:SOUR:DM:CLIS:CONT ON` *RST value is OFF

[:SOURce]:DM:CLISt:DATA <struc>{,<struc>}...

The command transmits the bit data to the selected control list which is then overwritten.

struc>=: <symbol-index>, <bin>, <bin>, <bin>, <bin>, <bin>, <bin>
<symbol-index> =: numeric value: 1 to 2^26 (67108864)
<bin> =: numeric value: 0 ¦ 1

The data can also be transmitted as a binary block with <struc> being a 4 byte value in which the 26 LSBs represent the symbol index and the remaining 6 bits the binary values (see also section parameter, block data). Each byte is interpreted as made up of 8 data bits. Here, the command `:SYSTem:COMMunicate:GPIB:LTERminator` EOI should be used to set the delimiter mode to 'circuit message EOI only' so that an accidental LF within the data sequence is not first identified as a delimiter and thus momentarily interrupts the data transmission.

The command `...LTER STANdard` resets the delimiter mode.

For the query, switchover between the two formats given above is possible by means of the `:FORMat ASCii | PACKed` command. The order of bytes is stipulated in the IEC/IEEE-bus standard (MSByte first).

It should be noted that in the binary form the symbol index starts with 0. In the binary format this means that each symbol index is less by 1 than actually indicated on the screen and input/output via IEC/IEEE-bus in the ASCII format.

Example:

```
:SOUR:DM:CLIS:DATA 12345678,0,1,1,0,0,0,23456789,1,0,0,1,0,0
:SOUR:DM:CLIS:DATA #18aX-'y$?s
```

The first two positions of the list are filled with the examples (with different values).

[:SOURce]:DM:CLISt:CATalog?

The command returns a list of data list names separated by commas.

Example: `:SOUR:DM:CLIS:CAT?`

[:SOURce]:DM:CLISt:SELect '<name>'

The command selects the indicated control list. This list only becomes effective as control list if the `:DM:PRAMp:SOURce CLISt` mode has been selected. The list can only be filled with values if it has been selected beforehand. If the indicated list does not exist, it will be generated. <name> has to be put in brackets (< >) and may have up to 7 characters.

Example: `:SOUR:DM:CLIS:SEL 'TEST2'`

[:SOURce]:DM:CLISt:DELete '<name>'

The command deletes the control list indicated by <name>. This command triggers an event and hence has no *RST value and no query

Example: `:SOUR:DM:CLIS:DEL 'TEST2'`

[:SOURce]:DM:CLISt:COPY '<name>'

The command copies the selected list to the data list indicated by <name>. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:DM:CLIS:COPY 'TEST2'`

[:SOURce]:DM:CLISt:FREE?

This command returns the available free space for the control data (lines consisting of 4 bytes) in elements.

Example: `:SOUR:DM:CLIS:FREE?`

[:SOURce]:DM:CLISt:POINts?

The command returns the number of elements (lines consisting of 4 bytes) of the currently selected list.

Example: `:SOUR:DM:CLIS:POIN?`

[:SOURce]:DM:MLISt:DATA A,B.C,D,E,F,I1,Q1,I2,Q2...

The command transmits the mapping data to the selected list which is therefore overwritten. The command can be used only if a list has been selected beforeheand (compare with `DM:MLISt:SELect`).

A: 1 for PSK modulation
2 for QAM modulation
3 for FSK modulation

B: 1 to 8, with $B = \log_2 m$ (mapping states)

C: 0 if no delay is to be used in the Q-path
1 if the Q-path is to be delayed by $T_{symbol}/2$ (e.g. for offset QPSK)

D: 0, reserved

E: 0, reserved

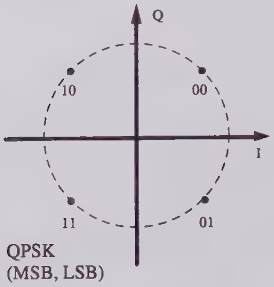
F: 0, reserved

I,Q: Floating point values for I and Q; m values for I and Q must be defined for PSK and QAM modulation. To define FSK all Q-values must be set to 0. The values have to be entered in ascending order starting with the least significant data symbol.

Example (for QPSK with m = 4):

```
:SOUR:DM:MLIS:DATA 1,2,0,0,0,0,0.7,0.7,0.7,-0.7,-0.7,0.7,-0.7,-0.7
```

The example results in the following IQ mapping



[:SOURce]:DM:MLISt:CATalog?

The command returns a list of mapping list names separated by commas.

Example: `:SOUR:DM:MLIS:CAT?`

[:SOURce]:DM:MLISt:SELect '<name>'

The command selects the indicated userdefined mapping list. This list only becomes effective as modulation if the `:DM:FORMat USER` mode has been selected. The list can only be filled with values if it has been selected beforehand. If the indicated list does not exist, it will be generated. <name> has to be put in brackets (< >) and may have up to 7 characters.

Example: `:SOUR:DM:MLIS:SEL 'test'`

[:SOURce]:DM:MLISt:DELete '<name>

The command deletes the mapping list indicated by <name>. This command triggers an event and hence has no *RST value and no query

Example: `:SOUR:DM:MLIS:DEL 'TEST2'`

[:SOURce]:DM:MLISt:FREE?

This command returns the available free space for the mapping data (lines consisting of 4 bytes) in elements.

Example: `:SOUR:DM:MLIS:FREE?`

[:SOURce]:DM:MLISt:POINts?

The command returns the number of elements (numbers) of the currently selected list.

Example: `:SOUR:DM:MLIS:POIN?`

[:SOURce]:DM:STANdard APCFm | APCQpsk | CDPD | CT2 | DECT | GSM | GSMEdge | IRIDium | FIS95 | RIS95 | NADC | PDC | PHS | TETRa | TFTS | PWT | ICOBpsk | ICOGmsk | ICOQpsk | WORLdspace | QWCDma | AT55

The command adjusts the modulation parameters MODULATION, SYMBOL RATE, FILTER and CODING to the selected standard. The default setting is USER. This setting is always activated automatically if one of the modulation parameters is changed and does not correspond to the selected standard. QWCDma is only available with option SMIQB47. WORLDspace only with option SMIQB17.

APCFm	APCO4FM
APCQpsk	APCOQPSK

Example: `:SOUR:DM:STAN PHS` *RST value USER

[:SOURce]:DM:FORMat BPSK | GFSK | GMSK | QPSK | QIS95 | QINMarsat | QICO | QWCDma | OQPSk | OIS95 | P4QPsk | P4DQpsk | PSK8 | PSKE8 | ASK | FSK2 | FSK4 | AFSK4 | QAM16 | QAM32 | QAM64 | QAM256 | USER

The command selects the modulation. QWCDma is only available with option SMIQB47.

P4DQpsk	π/4DQSPK
PSK2	is an alias for BPSK
PSK4	is alias for QPSK (according to SCPI).
QIS95	QPSK IS95
OIS95	OQPSK IS95
QWCDma	WCDMA QPSK
AFSK4	4FSK APCO
USER	The list selected with `DM:MLIS:SEL...` and defined via `DM:MLIS:DATA...` is used.

Example: `:SOUR:DM:FORM GMSK` *RST value is P4DQpsk

[:SOURce]:DM:MDELay?

Value for time delay of digital modulation between data input/output and RF output of SMIQ.

Example: `:SOUR:DM:MDEL?`

[:SOURce]:DM:FSK:DEViation 100 kHz to 2.5 MHz

The command sets the deviation for FSK (only for `DM:FORmat FSK2, FSK4` and `GFSK).`

Example: `:SOUR:DM:FSK:DEV 9 kHz` *RST value is 4.5 kHz

[:SOURce]:DM:SRATe 1kHz to 7 MHz

The command sets the symbol rate.

Example: `:SOUR:DM:SRAT 200 kHz` *RST value is 24.3 kHz

[:SOURce]:DM:FILTer

The filter selection commands are under this node.

[:SOURce]:DM:FILTer:TYPE SCOSine | COSine | GAUSs | LGAuss | BESS1 | BESS2 | IS95 | EIS95 | APCO | TETRa | WCDMa | RECTangle | SPHase

The command selects the type of filter.

BESS1	BESSEL B*T 1.25
BESS2	BESSEL B*T 2.50
EIS95	IS-95+EQUALIZER
APCO	filter according to standard APCO modulation C4FM

Example: `:SOUR:DM:FILT:TYPE GAUS` *RST value is SCOS

[:SOURce]:DM:FILTer:PARameter 0.1 to 1.0

The command sets the filter parameter (Roff Off or BxT rate).

Example: `:SOUR:DM:FILT:PAR 1` *RST value is 0.35

[:SOURce]:DM:FILTer:MODE LACP | LEVM

The command selects the filter mode.

Example: `:SOUR:DM:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:DM:CODing OFF | GSM | NADC | PDC | PHS | TETRa | TFTS | PWT | INMarsat | DIFF | DPHS | DGRay | APCO25 | VDL

The command selects the modulation coding (standard) .

DPHS	PHASE DIFF
DGRay	DIFF + DGRAY

Example: `:SOUR:DM:COD NADC` *RST value is OFF

[:SOURce]:DM:CLOCk

The commands for setting the data clock are under this node.

[:SOURce]:DM:CLOCk:SOURce INTernal | EXTernal | COUPled

The command selects the source for the clock of the digital modulation.

INTernal	The internal clock generator is used.
EXTernal	The clock is fed externally.
COUPled	The clock comes from the same source as the data. Selection is determined by `:DM:SOURce`.

Example: `:SOUR:DM:CLOC:SOUR INT` *RST value is COUPled

[:SOURce]:DM:CLOCk:MODE BIT | SYMBol

The command selects the clock mode for `:DM:CLOCk:SOURce EXTernal`

BIT	Only the input D_CLOCK is used.
SYMBol	Only the input S_CLOCK is used.

The bit and symbol clock only differ for modulations with more than two states, ie modulations for which more than one bit is required to code each state.

Example: `:SOUR:DM:CLOC:MODE BIT` *RST value is SYMBol

[:SOURce]:DM:CLOCk:DELay 0 to 1.0

The command sets the delay of the symbol clock.

Example: `:SOUR:DM:CLOC:DEL 0.2` *RST value is 0

[:SOURce]:DM:CLOCk:POLarity NORMal | INVerted

The command selects the active slope for the clock.

NORMal	SLOPE POS.
INVert	SLOPE NEG

Example: `:SOUR:DM:CLOC:POL INV` *RST value is NORMal

[:SOURce]:DM:LDIStortion[:STATe] ON | OFF

The command sets the reduced level for the low-distortion mode.

Example: `:SOUR:DM:LDIS ON` *RST value is OFF

[:SOURce]:DM:PRAMp

The commands for the level control of the burst are under this node.

[:SOURce]:DM:PRAMp[:STATe] ON | OFF

The command switches the level control on or off.

Example: `:SOUR:DM:PRAM ON` *RST value is OFF

[:SOURce]:DM:PRAMp:SOURce CLISt | AEXTernal | DEXTernal

The command selects the level control.

CLISt	The control list defined under `:DM:CLISt` controls the level (INT).
AEXT	Analog signal at the burst control input controls the level.
DEXT	Digital signals BURSt-GATE and LEV-ATT control the level.

Example: `:SOUR:DM:PRAM:SOUR DEXT` *RST value is CLISt

[:SOURce]:DM:PRAMp:TIME 0.25 to 32

The command sets the steep cutoff (as multiple of symbol length).

Example: `:SOUR:DM:PRAM:TIME 2.5` *RST value is 3.0

[:SOURce]:DM:PRAMp:DELay -1.0 to +5.0

The command defines the shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope.

Example: `:SOUR:DM:PRAM:DEL 0.2` *RST value is 0

[:SOURce]:DM:PRAMp:SHAPe LINear | COSine

The command selects the linear or cosine-square shape of the ramp-up and ramp-down (power burst).

Example: `:SOUR:DM:PRAM:SHAP COS` *RST value is COS

[:SOURce]:DM:PRAMp:ATTenuation 0 to 70 dB

The command sets the level reduction value.

Example: `:SOUR:DM:PRAM:ATT 12 dB` *RST value is 0 dB

[:SOURce]:DM:TRIGger:SOURce EXTernal | INTernal

The command selects the trigger source.

EXT	Triggering via external trigger input.
INT	Triggering via IEC/IEEE bus or the Execute command of manual control.

Example: `:SOUR:DM:TRIG: EXT` *RST value is INTernal

[:SOURce]:DM:TRIGger:INHibit 0 to 67.1E6

The command sets the retrigger inhibit duration in number of symbols.

Example: `:SOUR:DM:TRIG:INH 12000` *RST value is 0

[:SOURce]:DM:TRIGger:DELay 0 to 65535

The command sets the trigger delay in number of symbols.

Example: `:SOUR:DM:TRIG:DEL 10` *RST value is 0

[:SOURce]:DM:TRIGger:SLOPe POSitive | NEGative

The command selects the active slope of the external trigger signal.

Example: `:SOUR:DM:TRIG:SLOP NEG` *RST value is POSitive.

[:SOURce]:DM:THReshold[:ALL] -2.5 to +2.5V

The command sets the voltage threshold of the digital data and clock inputs.

Example: `:SOUR:DM:THR 1 V` *RST value is 1.0 V

[:SOURce]:DM:INPut:IMPedance G1K | G50 | ECL

The command sets the impedance of all the data and clock inputs:

G1K	1 kOhm to ground
G50	50 Ohm to ground
ECL	ECL-compatible input

Example: `:SOUR:DM:INP:IMP G50` *RST value is G1K

3.5.11.6 SOURce:FM Subsystem

This subsystem contains the commands to check the frequency modulation and to set the parameters of the modulation signal. The SMIQ can be equipped with two independent frequency modulators (option SM-B5). They are differentiated by a suffix after FM.

SOURce:FM1
SOURce:FM2

Command	Parameter	Default Unit	Remark
[:SOURce]			
:FM1I2			Option SM-B5
[:DEViation]	0 to 1MHz	Hz	
:EXTernal1I2			
:COUPling	AC I DC		
:INTernal			
:FREQuency	0.1 Hz to 1 MHz	Hz	
:PREemphasis	0 I 50us I 75us		
:SOURce	INT I EXT1 I EXT2		
:STATe	ON I OFF		

[:SOURce]:FM1I2[:DEViation] 0 to 1 MHz

The command specifies the frequency variation caused by the FM. Although the LF generator is used as modulation sources, the frequency variation is independent of the voltage at the LF output. The maximally possible DEViation depends on `SOURce:FREQuency` (cf. data sheet).

Example: `:SOUR:FM1:DEV 5kHz` *RST value is 10 kHz

[:SOURce]:FM1I2:EXTernal1I2

The commands to set the external FM input are under this node. The settings under EXTernal for modulations AM, FM and PM are independent of each other. The settings are always related to the socket which is determined by the numeric suffix after EXTernal. The suffix after FM is ignored then. With the following commands, e.g., the settings are both related to EXT2 input:

```
:SOUR:FM1:EXT2:COUP AC
```

```
:SOUR:FM2:EXT2:COUP AC
```

A command without suffix is interpreted like a command with suffix 1.

[:SOURce]:FM1I2:EXTernal1I2:COUPling AC I DC

The command selects the type of coupling for the external FM input.

AC	The d.c. voltage content is separated from the modulation signal.
DC	The modulation signal is not altered.

*RST value is AC

Example: `:SOUR:FM:EXT:COUP AC`

[:SOURce]:FM1|2:INTernal

The settings for the internal FM generators are effected under this node. For FM1, this is always the internal LF generator. Here the same hardware is set for FM1, PM1, AM:INT as well as SOURce2. For FM2, only the external sources can be used (not the internal LF generator).

This means that, e.g., the following commands are coupled with each other and have the same effect:

```
SOUR:AM:INT:FREQ
SOUR:FM:INT:FREQ
SOUR:PM:INT:FREQ
SOUR2:FREQ:CW
```

[:SOURce]:FM1|2:INTernal:FREQuency 0.1 Hz to 1 MHz

The command sets the modulation frequency.

Example: `:SOUR:FM:INT:FREQ 10kHz` *RST value is 1 kHz

[:SOURce]:FM1|2:PREemphasis 0 | 50us | 75us

The command selects the preemphasis.

0	No preemphasis
50 us	50 μs, European standard 50 μs
75 us	75 μs, American standard 75 μs

*RST value is 0

Example: `:SOUR:FM:PRE 50us`

[:SOURce]:FM1|2:SOURce INTernal | EXTernal1 | EXTernal2

The command selects the modulation source. A command without suffix is interpreted like a command with suffix 1. The LF generator is INT for FM1. The external and the internal modulation source can be indicated at the same time (see example)

*RST value for FM1: INT
for FM2:EXT2

Example: `:SOUR:FM:SOUR INT1, EXT2`

[:SOURce]:FM1|2:STATe ON | OFF

The command switches the frequency modulation on or off. *RST value is OFF.

Example: `SOUR:FM:STAT OFF`

3.5.11.7 SOURce:FREQuency Subsystem

This subsystem contains the commands for the frequency settings of the RF source including the sweeps.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:FREQuency			
:CENTer	300 kHz to RF_{max}	Hz	RF_{max} depends on model
[:CW|:FIXed]	300 kHz to RF_{max}	Hz	RF_{max} depends on model
:RCL	INCLude | EXCLude		
:MANual	300 kHz to RF_{max}	Hz	RF_{max} depends on model
:MODE	CW | FIXed | SWEep | LIST		
:OFFSet	-50 to +50 GHz	Hz	
:SPAN	0 to RF_{max}	Hz	RF_{max} depends on model
:STARt	300 kHz to RF_{max}	Hz	RF_{max} depends on model
:STOP	300 kHz to RF_{max}	Hz	RF_{max} depends on model
:STEP			
[:INCRement]	0 to 1 GHz	Hz	

[:SOURce]:FREQuency:CENTer 300 kHz to RF_{max} (RF_{max} depending on model)

The command sets the sweep range by means of the center frequency. This command is coupled to commands `:SOURce:FREQuency:STARt` and `:SOURce:FREQuency:STOP`.

In this command, value OFFSet is considered as with input value FREQUENCY in the header field. Thus the specified range indicated is only valid for OFFSet = 0. The specified range with other OFFSet values can be calculated according to the following formula (cf. Chapter 2, Section "Frequency Offset" as well):

300 kHz + OFFSet to 2.2 GHz +OFFSet *RST value is (STARt +STOP)/2

Example: `:SOUR:FREQ:CENT 100kHz`

[:SOURce]:FREQuency[:CW|:FIXed] 300 kHz to RF_{max} (RF_{max} depending on model)

The command sets the frequency for CW operation. This value is coupled to the current sweep frequency. In addition to a numeric value, UP and DOWN can be indicated. The frequency is increased or reduced by the value set under `:SOURce:FREQuency:STEP`. (As to specified range, cf. `FREQuency:CENTer`).

Example: `:SOUR:FREQ:CW 100kHz` *RST value is 100 MHz

[:SOURce]:FREQuency[:CW|:FIXed]:RCL INCLude | EXCLude

The command determines the effect of the recall function on the frequency. *RST value has no effect to this setting.

INCLude	The saved frequency is loaded when instrument settings are loaded with the [RECALL] key or with a memory sequence.
EXCLude	The RF frequency is not loaded when instrument settings are loaded, the current settings are maintained.

Example: `:SOUR:FREQ:RCL INCL`

[:SOURce]:FREQuency:MANual 300 kHz to RF$_{max}$ (RF$_{max}$ depending on model)

The command sets the frequency if `SOURce:SWEep:MODE MANual` and `SOURce:FREQuency:MODE SWEep` are set. Only frequency values between the settings with `:SOURce:FREQuency:STARt` and `:SOURce:FREQuency:STOP` are permitted. (As to specified range, cf. `FREQuency:CENTer`) *RST value is 100 MHz

Example: `:SOUR:FREQ:MAN 500MHz`

[:SOURce]:FREQuency:MODE CW | FIXed | SWEep | LIST

The command specifies the operating mode and hence also specifies which commands check the FREQuency subsystem. The following allocations are valid

CW | FIXed	CW and FIXed are synonyms. The output frequency is specified by means of `:SOURce:FREQuency:CW	FIXed`.
SWEep	The instrument operates in the SWEep operating mode. The frequency is specified by means of commands `SOURce:FREQuency:STARt; STOP; CENTer; SPAN; MANual`.
LIST	The instrument processes a list of frequency and level settings. The settings are effected in the SOURce:LIST subsystem. Setting `SOURce :FREQuency:MODE LIST` automatically sets command `SOURce:POWer :MODE to LIST` as well.

Example: `:SOUR:FREQ:MODE SWE` *RST value is CW

[:SOURce]:FREQuency:OFFSet -50 to + 50 GHz

The command sets the frequency offset of an instrument which might be series-connected, e.g. a mixer. (cf. Chapter 2, Section "Frequency Offset"). If a frequency offset is entered, the frequency entered using SOURce:FREQuency: to does no longer correspond to the RF output frequency. The following connection is true:

`SOURce:FREQuency:to` = RF output frequency `+ SOURce:FREQuency:OFFSet`.

Entering an offset does not alter the RF output frequency but the query value of `SOURce:FREQuency:..`

Example: `:SOUR:FREQ:OFFS 100MHz` *RST value is 0

[:SOURce]:FREQuency:SPAN 0 to RF$_{max}$ (RF$_{max}$ depending on model)

This command indicates the frequency range for the sweep. This parameter is coupled to the start and stop frequency. Negative values for SPAN are permitted, then STARt > STOP is true. There is the following connection:

STARt = CENTer – SPAN/2
STOP = CENTer + SPAN/2 *RST value is (STOP - STARt)

Example: `:SOUR:FREQ:SPAN 1GHz`

[:SOURce]:FREQuency:STARt 300 kHz to RF$_{max}$ (RF$_{max}$ depending on model)

This command indicates the starting value of the frequency for the sweep operation. Parameters STARt, STOP, SPAN and CENTer are coupled to each other. STARt may be larger than STOP. (As to specified range, cf. `FREQuency:CENTer`). *RST value is 100MHz

Example: `:SOUR:FREQ:STAR 1MHz`

[:SOURce]:FREQuency:STOP 300 kHz to RF_{max} (RF_{max} depending on model)

This command indicates the final value of the frequency for the sweep operation (see STARt as well). (As to specified range, cf. `FREQuency:CENTer`). *RST value is 500MHz

Example: `:SOUR:FREQ:STOP 100MHz`

[:SOURce]:FREQuency:STEP

The command to enter the step width for the frequency setting if frequency values UP or DOWN are used is under this node. This command is coupled to the KNOB STEP command in manual control. Only linear step widths can be set.

[:SOURce]:FREQuency:STEP[:INCRement] 0 to 1 GHz

The command sets the step width for the frequency setting.

Example: `:SOUR:FREQ:STEP:INCR 1MHz` *RST value is 1MHz

3.5.11.8 SOURce:FSIM-Subsystem

The FSIM system comprises the commands for the fading simulator (options SMIQB14 and SMIQB15).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:FSIMulator			Option SMIQB14
[:STATe]	ON | OFF		
:CONFigure	S6Path | S12Path | D6Path		S12P and D6P only with option SMIQB15
:SEQuence	RUN | STOP		
:RESet			
:STANdard	CDMA8 | CDMA30 | CDMA100 | NADC8 | NADC50 | NADC100 | GTU3 | G6TU3 | GTU50 | G6TU50 | GHT100 |G6HT100 | GRA250 | GET50 | GET100 | PTU1 | P6TU1 | PTU50 | P6TU50 | PHT100 | P6HT100 | PRA130 | PET50 | PET100 | TTU | THT | TET		
:SPEed			
:UNIT	MPS | KMPH | MPH		
:ILOSs			
:MODE	NORMal | LACP		
:COUPle			
:SPEed	ON | OFF		
:CORRelation			
:COEFficient	ON | OFF		
:LOGNormal			
:LCONstant	ON | OFF		
:CSTD	ON | OFF		
:CFACtor			
:EXTern?			query only
:DEFault			
:PATH<i>	<i> = 1 to 6 (12)		7 to 12 only with SMIQB15
:STATe	ON | OFF		
:PROFile	PDOPpler | RAYLeigh | RICE | CPHase		
:DCOMponent			
:STATe	ON | OFF		
:PRATio	-30.0 to +30.0 dB	dB	
:FRATio	-1.0 to +1.0		
:CPHase	0 to 360	DEG	
:SPEed	0.005 to 27 777 MPS		depending on FSIM:SPE:UNIT: MPS | KMPH | MPH
:FDOPpler	0.1 to 1600.0 Hz	Hz	
:LOSS	0 to 50.0 dB	dB	
:DELay	0 to 1638.0E-6	s	
:CORRelation			
:PATH	0 | 7 to 12		
:COEFficent	0 to 1.0		
:PHASe	0 to 359	DEG	
:LOGNormal			
:STATe	ON | OFF		
:LCONstant	1 to 99 999		
:CSTD	0 to 12.0	dB	

[:SOURce]:FSIMulator[:STATe] ON | OFF

Switches the fading simulator on or off. *RST value: OFF

Example: `:SOUR:FSIM ON`

[:SOURce]:FSIMulator:CONFigure S6Path | S12Path | D6Path

Defines the number of active paths and channels. S12Path and D6Path are only possible with option SMIQB15.

S6Path	Single channel, 6 active paths
S12Path	Single channel, 12 active paths
D6Path	Dual channel, 6 active paths

Example: `:SOUR:FSIM:CONF S6P` *RST value: S6P/S12P (without/with option SMIQB15)

[:SOURce]:FSIMulator:SEQuence RUN | STOP

This command starts (RUN) or stops (STOP) the Pseudo Noise Generator for generating the fading process. *RST value: STOP

Example: `:SOUR:FSIM:SEQ RUN`

[:SOURce]:FSIMulator:SEQuence:RESet

This command resets the pseudo random sequence for the fading to its original value. `FSIMulator:SEQuence` is set to `STOP` (and has to be restarted with `RUN`). Since this command triggers an event it has no *RST value.

Example: `:SOUR:FSIM:SEQ:RES`

[:SOURce]:FSIMulator:STANdard CDMA8 | CDMA30 | .....

Selects the fading standard. All subsequent FSIM commands are set to a predefined value. The parameters with a '6' as second character select the 6-path mode (this mode must be set if option SMIQB15, Second Fading Generator is not available).

CDMA8. CDMA30, CDMA100	
NADC8, NADC50, NADC100	
GTU3, G6TU2, GTU50, G6TU50	GSM Typical Urban
GHT100, G6HT100	GSM Hilly Terrain
GRA250	GSM Rural Area
GET50, GET100	GSM Equal Test
PTU1, P6TU1, PTU50, P6TU50	DCS1800/PCS1900 Typical Urban
PHT100, P6HT100	DCS1800/PCS1900 Hilly Terrain
PRA130	DCS1800/PCS1900 Rural Area
PET50, PET100	DCS1800/PCS1900 Equal Test
TTU	Tetra Typical Urban
THT	Tetra Hilly Terrain,
TET	Tetra Equal Test

Example: `:SOUR:FSIM:STAN NADC50` *RST value: CDMA8

[:SOURce]:FSIMulator:SPEed:UNIT MPS | KMPH | MPH

This command selects the speed unit.

MPS	m/s, meter per second
KMPH	km/h, kilometer per hour
MPH	miles per hour

Example: `:SOUR:FSIM:SPE:UNIT MPH` *RST value: MPS

[:SOURce]:FSIMulator:ILOSs:MODE NORMal | LACP

This command sets the insertion loss of the fading simulator.

NORMal	The insertion loss is fixed to 18 dB, which is ideal for BER measurements.
LACP	The insertion loss is between 12 and 14 dB to obtain a better S/N ratio, for instance during adjacent-channel measurements.

Example: `:SOUR:FSIM:ILOS:MODE LACP` *RST value is NORMal

[:SOURce]:FSIMulator:COUPle

The commands for coupling the settings for all paths are under this node. If the following coupling commands are set to ON, the modification of a value for a path (path<i>) will be accepted by all other paths. When switching for the first time from OFF to ON, all paths will be set to the value of path 1.

[:SOURce]:FSIMulator:COUPle:SPEed ON | OFF

This command couples the setting of `:FSIM:PATH<i>:SPE` for all paths.

Example: `:SOUR:FSIM:COUP:SPE ON` *RST value is OFF

[:SOURce]:FSIMulator:COUPle:CORRelation:COEFficient ON | OFF

This command couples the setting of `:FSIM:PATH<i>:CORR:COEF` for all paths.

Example: `:SOUR:FSIM:COUP:CORR:COEF ON` *RST value is OFF

[:SOURce]:FSIMulator:COUPle:LOGNormal:LCONstant ON | OFF

This command couples the setting of `:FSIM:PATH<i>:LOGN:LCON` for all paths.

Example: `:SOUR:FSIM:COUP:LOGN:LCON ON` *RST value is OFF

[:SOURce]:FSIMulator:COUPle:LOGNormal:CSTD ON | OFF

This command couples the setting of `:FSIM:PATH<i>:LOGN:CSTD` for all paths.

Example: `:SOUR:FSIM:COUP:LOGN:CSTD ON` *RST value is OFF

[:SOURce]:FSIMulator:CFACtor:EXTern?

With this command the crest factor to be set on the second SMIQ can be read out (for 2-channel fading).

Example: `:SOUR:FSIM:CFAC:EXT?`

[:SOURce]:FSIMulator:DEFault

This command selects the default setting of the path parameters. Path 1 is switched on; all other paths are switched off. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:FSIM:DEF`

[:SOURce]:FSIMulator:PATH<i>

The following commands can be separately set for each path. The path is selected with the suffix <i>; <i> being assigned a value from 1 to 6 (one fading simulator) or 1 to 12 (two fading simulators).

[:SOURce]:FSIMulator:PATH<i>:STATE ON | OFF

This command switches the selected path on or off.

Example: `:SOUR:FSIM:PATH3:STAT ON` *RST value is OFF

[:SOURce]:FSIMulator:PATH<i>:PROFile PDOPpler | RAYLeigh | RICE | CPHase

This command assigns a fading profile (scattering image) to the selected path.

PDOPpler	pure doppler profile.
RAYLeigh	standard Rayleigh profile
RICE	standard Rice profile
CPHase	constant phase

Example: `:SOUR:FSIM:PATH3:PROF RICE` *RST value is RAYL

[:SOURce]:FSIMulator:PATH<i>:DCOMponent:STATe ON | OFF

This command switches the descrete components on or off. *RST value is OFF

Example: `:SOUR:FSIM:PATH3:CCOM:STAT ON`

[:SOURce]:FSIMulator:PATH<i>:PRATio -30 to +30 dB

This command sets the power ratio (for RICE profile only). The resolution is 0.1 dB.

Example: `:SOUR:FSIM:PATH3:PRAT -20` *RST value is 0

[:SOURce]:FSIMulator:PATH<i>:FRATio -1.0 to +1.0

The command sets the frequency ratio (for RICE profile only). The resolution is 0.1.

Example: `:SOUR:FSIM:PATH3:FRAT 0.5` *RST value is 1

[:SOURce]:FSIMulator:PATH<i>:CPHase 0 to 360 DEG

The command sets the phase for CPHAS fading.

Example: `:SOUR:FSIM:PATH6:CPH  20.0` *RST value is 0

[:SOURce]:FSIMulator:PATH<i>:SPEed 0.005 to 27 777 (in MPS (m/s))

This command sets the vehicle speed. The unit is defined separately with the command `FSIM:SPEed:UNIT`.

Example: `:SOUR:FSIM:PATH3:SPE 10.0` *RST value is 20 MPS

[:SOURce]:FSIMulator:PATH<i>:FDOPpler 0.1 to 1600 Hz

This command specifies the Doppler frequency (coupled to the vehicle speed). The resolution is 0.1 Hz.

Example: `:SOUR:FSIM:PATH3:FDOP 100` *RST value is 6.7

[:SOURce]:FSIMulator:PATH<i>:LOSS 0 to 50.0 dB

This command sets the path loss. The resolution is 0.1 dB. *RST value is 0

Example: `:SOUR:FSIM:PATH3:LOSS 20`

[:SOURce]:FSIMulator:PATH<i>:DELay 0 to 1638.0E-6

This command sets the signal delay in the path. The resolution is 50 ns. *RST value is 0

Example: `:SOUR:FSIM:PATH3:DEL 123E-6`

[:SOURce]:FSIMulator:PATH<i>:CORRelation

This node provides the commands for setting the correlation to another path (only with option SMIQB15).

[:SOURce]:FSIMulator:PATH<i>:CORRelation:PATH 0 | 7 to 12

This command defines the correlating path 7 to 12 for path <n>. If no correlation exists, 0 is selected.

Example: `:SOUR:FSIM:PATH3:CORR:PATH 12` *RST value is 0

[:SOURce]:FSIMulator:PATH<i>:CORRelation:COEFficent 0 to 1.0

This command sets the correlation coefficient. The resolution is 0.05. *RST value is 1

Example: `:SOUR:FSIM:PATH3:CORR:COEF 0.3`

[:SOURce]:FSIMulator:PATH<i>:CORRelation:PHASe 0 to 359 degree

This command sets the correlation phase. The resolution is 1 degree. *RST value is 0

Example: `:SOUR:FSIM:PATH3:CORR:PHAS 180`

[:SOURce]:FSIMulator:PATH<i>:LOGNormal

This node provides the commands for setting the lognormal fading.

[:SOURce]:FSIMulator:PATH<i>:LOGNormal:STATe ON | OFF

This command switches lognormal fading on or off. *RST value is OFF

Example: `:SOUR:FSIM:PATH3:LOGN:STAT OFF`

[:SOURce]:FSIMulator:PATH<i>:LOGNormal:LCONstant 1 to 99 999

This command enters the local constant in meters. The unit is not a component of this command.The resolution is 0.1 m. *RST value is 200

Example: `:SOUR:FSIM:PATH3:LOGN:LCON 50`

[:SOURce]:FSIMulator:PATH<i>:LOGNormal:CSTD 0 to 12.0 dB

This command sets the standard deviation of lognormal fading. The resolution is 1 dB.

Example: `:SOUR:FSIM:PATH3:LOGN:CSTD 2.0` *RST value is 0

3.5.11.9 SOURce:GSM Subsystem (Digital Standard)

Note: *#B0 to #B1 are characters which are entered in binary form manually. SCPI (and IEEE 488.2) also accept the entry of non-numeric characters in octal and hex such as*
#Hlh <0 to 9, Ala to Flf>,
#Qlq <0 to 7> and
#Blb <0l1>.
The characters are always output in binary format after a query.

Command	Parameter	Default unit	Remark
[:SOURce]			
:GSM			
:STATe	ON I OFF		
:STANdard			no query
:FORMat	GMSK I GFSK		
:FSK			
:DEViation	1kHz to 300 kHz	Hz	
:SRATe	1kHz to 300 kHz	Hz	
:FILTer			
:PARameter	0.2 to 0.7		
:SEQuence	AUTO I RETRigger I AAUTo I ARETrigger		
:TRIGger			
:SOURce	EXTernal I INTernal		
:INHibit	0 to 67.1E6		
:DELay	0 to 65535		
:OUTPut[2]			
:DELay	0 to 1249		
:PERiod	1 to 67.1E6		
:CLOCk			
:SOURce	INTernal I EXTernal		
:DELay	0 to 1.0		
:PRAMp			
:PRESet			no query
:TIME	0.25 to 16		
:SHAPe	LINear I COSine		
:DELay	-1.0 to +1.0		
:ROFFset	-9 to +9		
:FOFFset	-9 to +9		
:SLOT			
:ATTenuation	0 to 70 dB	dB	

Command	Parameter	Default unit	Remark
[:SOURce]			
:GSM			
:FLISt			
:PREDefined			
:CATalog?			query only
:LOAD	'name'		
:CATalog?			query only
:LOAD	'name'		
:STORe	'name'		no query
:DELete	'name'		no query
:DLISt			
:CATalog?			query only
:SLOT<i>			i=0,[1],2 to 7 (Slot Selector)
:TYPE	NORMal I DUMMy I ADATa		
:LEVel	OFF I ATT I FULL		
:PRESet			
:HOPPing			
:TRIGger	ON I OFF		
[:SOURce]			
:DATA	PN9 I PN11I PN15 I PN 16 I PN20 I PN21 I PN23 I DLISt I SDATa		
:DLISt	'name'		
:SF	0 I 1		
:TSC			
:SELect	T0 to T7 I USER		
:USER	#B0 to #B1111 to (26 bits)		

[:SOURce]:GSM:STATe ON I OFF

The command switches the modulation on according to GSM standard. All other standards that might be switched on or digital modulation are automatically switched OFF.

Example: `:SOUR:GSM:STAT ON` *RST value is OFF

[:SOURce]:GSM:STANdard

The commands sets all modulation parameters to the values of the GSM standard. I.e., all values that have been selected by the `:GSM:SLOT...` commands described in the following are not valid. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:GSM:STAN`

[:SOURce]:GSM:FORMat GMSK I GFSK

This command selects the modulation type.

Example: `:SOUR:GSM:FORM GFSK` *RST value is GMSK

[:SOURce]:GSM:FSK:DEViation 1kHz to 300 kHz

This command sets the deviation for `GSM:FORMat GFSK`. The range of values depends on the symbol rate (`GSM:SRATe`).

Example: `:SOUR:GSM:FSK:DEV 37.6kHz` *RST value is 67.708 kHz

[:SOURce]:GSM:SRATe 1kHz to 300 kHz

The command sets the symbol rate.

Example: `:SOUR:GSM:SRAT 270.9 kHz` *RST value is 270.833 kHz

[:SOURce]:GSM:FILTer:PARameter 0.2 to 0.7

The command sets the filter parameter.

Example: `:SOUR:GSM:FILT:PAR 0.4` *RST value is 0.3

[:SOURce]:GSM:SEQuence AUTO I RETRigger I AAUTo I ARETrigger

The command selects the trigger mode for the sequence.

AAUTo is	ARMED AUTO
ARETrigger is	ARMED RETRIG

Example: `:SOUR:GSM:SEQ AAUT` *RST value is AUTO

[:SOURce]:GSM:TRIGger:SOURce EXTernal I INTernal

The command selects the trigger source. With INT selected, triggering is via IEC/IEEE bus or the Execute command in manual control.

Example: `:SOUR:GSM:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:GSM:TRIGger:INHibit 0 to 67.1E6

The command sets the retrigger inhibit duration (in number of symbols).

Example: `:SOUR:GSM:TRIG:INH 1000` *RST value is 0

[:SOURce]:GSM:TRIGger:DELay 0 to 65535

The command sets the trigger delay (in number of symbols).

Example: `:SOUR:GSM:TRIG:DEL 200` *RST value is 0

[:SOURce]:GSM:TRIGgerOUTPut[2]:DELay 0 to 1249

The command determines the delay of the signal at trigger output 2 in comparison with the start of the frames in number of symbols.

Example: `:SOUR:GSM:TRIG:OUTP2:DEL 16` *RST value is 0

[:SOURce]:GSM:TRIGger:OUTPut[2]:PERiod 1 to 67.1E6

The command sets the repeat rate (in number of frames) of the signal at trigger output 2.

Example: `:SOUR:GSM:TRIG:OUTP:PER 8` *RST value is 1

[:SOURce]:GSM:CLOCk

The commands for setting the data clock are under this node.

[:SOURce]:GSM:CLOCk:SOURce INTernal I EXTernal

The command selects the source for the DM data clock.

INTernal	The internal clock generator is used and output via the clock outputs of the serial and parallel interface.
EXTernal	The clock is externally fed in via the serial interface and output via the parallel interface.

Example: `:SOUR:GSM:CLOC:SOUR INT` *RST value is INT

[:SOURce]:GSM:CLOCk:DELay 0 to 1.0

The command sets the delay of the symbol clock (as a fraction of the length of a symbol).

Example: `:SOUR:GSM:CLOC:DEL 0.75` *RST value is 0

[:SOURce]:GSM:PRAMp

The commands for the level control of the burst are under this node.

[:SOURce]:GSM:PRAMp:PRESet

This command sets the standard-stipulated values for the following commands of level control. It is an event and hence has no query and no *RST value.

Example: `:SOUR:GSM:PRAM:PRES`

[:SOURce]:GSM:PRAMp:TIME 0.25 to 16.0

The command sets the cutoff steepness (in symbol clocks).

Example: `:SOUR:GSM:PRAM:TIME 2.5` *RST value is 3

[:SOURce]:GSM:PRAMp:DELay -1.0 to + 1.0

The command defines the shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope.

Example: `:SOUR:GSM:PRAM:DEL 0.2` *RST value is 0

[:SOURce]:GSM:PRAMp:SHAPe LINear I COSine

The command selects the linear or cosine shape of the ramp-up and ramp-down (power burst).

Example: `:SOUR:GSM:PRAM:SHAP COS` *RST value is COS

[:SOURce]:GSM:PRAMp:ROFFset -9 to +9

The command determines the timing of the ('R'ising) edge of a power burst to the beginning of the block.

Example: `:SOUR:GSM:PRAM:ROFF -3` *RST value is 0

[:SOURce]:GSM:PRAMp:FOFFset -9 to +9

The command determines the timing of the ('F'alling) edge of a power burst to the data block

Example: `:SOUR:GSM:PRAM:FOFF 4` *RST value is 0

[:SOURce]:GSM:SLOT:ATTenuation 0 to -70 dB

The command determines the amount by which the power of the slots marked by `:GSM:SLOT:LEVEL ATT` is reduced in comparison with the normal output power (Attribut to `:LEVEL FULL`).

Example: `:SOUR:GSM:SLOT:ATT 20 dB` *RST value is 0

[:SOURce]:GSM:FLISt

The commands for storing and reading complete frames including their bursts (slots) are under this node. Predefined and user-generated frames have to be distinguished.

[:SOURce]:GSM:FLISt:PREDefined:CATalog?

The command returns a list of all predefined frames.

Example: `:SOUR:GSM:FLIS:PRED:CAT?`

[:SOURce]:GSM:FLISt:PREDefined:LOAD 'name'

The command selects one of the predefined (fixed) frames (c.f. Chapter 2). This command triggers an event and hence has no *RST value.

Example: `:SOUR:GSM:FLIS:PRED:LOAD 'NB0'`

[:SOURce]:GSM:FLISt:CATalog?

The command returns a list of all user-defined frames.

Example: `:SOUR:GSM:FLIS:CAT?`

[:SOURce]:GSM:FLISt:LOAD 'name'

The command loads a user-defined frame. This command triggers an event and hence has no *RST value.

Example: `:SOUR:GSM:FLIS:LOAD 'test'`

[:SOURce]:GSM:FLISt:STORe 'name'

The command stores the current frame under a name. This command triggers an event and hence has no *RST value.

Example: `:SOUR:GSM:FLIS:STOR 'test'`

[:SOURce]:GSM:FLISt:DELete ‘name’

The command deletes the indicated frame. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:GSM:FLIS:DEL 'test1'`

[:SOURce]:GSM:DLISt:CATalog?

The command returns an enumeration of all data lists.

These data lists are selected by means of `:GSM:SLOT:DATA 'name'` and used if `:GSM:SLOT:DATA DLISt` is set.

Example: `:SOUR:GSM:DLIS:CAT?`

[:SOURce]:GSM:SLOT<i>

The commands for setting the slot characteristics are under this node. Since a frame contains 8 slots, suffix ‘i’ is used to select the slot to be changed. i = 0 | [1] | 2 | 3 | 3 | 5 | 6 | 7

[:SOURce]:GSM:SLOT<i>:TYPE NORM | DUMMy | ADATa

The command selects the type of burst (slot) defined in the standard.

ADATa is All Data

Example: `:SOUR:GSM:SLOT2:TYPE DUMM` *RST value is NORM

[:SOURce]:GSM:SLOT<i>:LEVel OFF | ATT | FULL

The command determines the power stage of the slot.

OFF	The slot is inactive
ATT	The power is reduced by the amount defined by `:GSM:SLOT:ATT`
FULL	Full power (predefined by level setting)

Example: `:SOUR:GSM:SLOT2:LEV ATT` Slot 0: *RST value is FULL

Slot 1 to 7: *RST value is OFF

[:SOURce]:GSM:SLOT<i>:PRESet

The command sets all the parameters of the slot to the values defined by the standard as a function of the type set above. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:GSM:SLOT2:PRES`

[:SOURce]:GSM:SLOT<i>:HOPPing:TRIGger ON | OFF

This command provides a trigger signal at the PARDATA connector (ON). This signal can be used to perform frequency hopping in the LIST MODE.

Example: `:SOUR:GSM:SLOT2:HOPP:TRIG ON` *RST value is OFF

[:SOURce]:GSM:SLOT<i>[:SOURce]:DATA PN9 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the data words (for `:SLOT:TYPE NORM` and `ADATa`)

Example: `:SOUR:GSM:SLOT2:DATA PN15` *RST value is PN9

[:SOURce]:GSM:SLOT<i>[:SOURce]:DATA:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:GSM:SLOT:DATA DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:GSM:SLOT:DATA:DLIS 'test'`

[:SOURce]:GSM:SLOT<i>:SF 0 | 1

This command sets the stealing flag (`GSM:SLOT:TYPE NORM` only)

Example: `:SOUR:GSM:SLOT2:SFR:STAT ON` *RST value is OFF

[:SOURce]:GSM:SLOT<i>:TSC:SELect T0 to T7 | USER

This commands selects the training sequence code. 0 to 7 are the TSC values stipulated by GSM 5.02. With USER selected as parameter, the given value described with the following `...:TSC:USER` command will be used.

Example: `:GSM:SLOT:TSC:SEL 3` *RST value is 0

[:SOURce]:GSM:SLOT<i>:TSC:USER #B0 to #B1111... (26 bits)

The TSC value is determined by the user by means of this command. TSC will be used if the parameter (!) USER is set by means of the above-mentioned `:GSM:SLOT:TSC` command.

Example: `:GSM:SLOT:TSC:USER #B01101100110011100011111100`

*RST value is 111111111

3.5.11.10 SOURce:IS95 Subsystem (Digital Standard IS-95 CDMA)

Command	Parameter	Default unit	Remark
[:SOURce]			
:IS95			
:STATe	ON | OFF		
:MODE	FLINk18 | FLINk64 | RLINk		
:PRESet			
:CRATe	1kHz to 7 MHz	Hz	
:FILTer			
:FTYPe	SCOSine | COSine | IS95 | EIS95		
:RTYPe	SCOSine | COSine | IS95 | EIS95		
:PARameter	0.1 to 0.7		
:MODE	LACP | LEVM		
:LDIStortion			
[:STATe]	ON | OFF		
:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger		
:TRIGger			
:SOURce	EXTernal | INTernal		
:INHibit	0 to 67108863		
:DELay	0 to 65535		
:OUTPut[1]|2	TFRame | SSRollover | SFRame | ESECond		
:DELay	-32768 to 32768		
:POLarity	POSitive | NEGative		
:CLOCk			
:MODE	CHIP | CHIP4 | CHIP8 | CHIP16		
:SOURce	INTernal | EXTernal		
:DELay	0 ... 1,00		
:POWer?			query only
:ADJust	-		
:MAPPing			
:PREDefined			
:CATalog?	⇒ name {,name}		query only
:LOAD	'name'		
:CATalog?	⇒ name {,name}		query only
:LOAD	'name'		No query
:STORe	'name'		No query
:DELete	'name'		No query
:CHANnel<0..63>			
:WALShcode	0 to 63		
:POWer	-30 dB to 0 dB	dB	
:DATA	ZERO | ONE | ALTernate | PRBS		
:STATe	ON | OFF		
:RATE	FULL | HALF		
:RANDomizer			
:[:STATe]	ON | OFF		
:DATA	ZERO | ONE | ALTernate | PRBS | DATA		

Command	Parameter	Default unit	Remark
[:SOURce]			
:IS95			
:DLISt	'name'		
:CATalog?	⇒ name {,name}...		query only
:RLCoded			
:CTYPe	TRAF14400 | TRAF7200 | TRAF3600 | TRAF1800 | ACC4800 | TRAF9600 | TRAF4800 | TRAF2400 | TRAF1200		
:DATA	PN9 | PN11| PN15 | PN16 | PN20 | PN21 | PN23 | DLISt		
:DLISt	'name'		
:FQINdicator	ON | OFF		
:CENCoder	ON | OFF		
:BINTerleaver	ON | OFF		
:EBIT	0 | 1		

[:SOURce]:IS95:STATe ON | OFF

The command switches the modulation on according to the IS95 standard which is a CDMA method. All other standards or digital modulation that might be switched on are automatically switched off (OFF).

Example: `:SOUR:IS95:STAT ON` *RST value is OFF

[:SOURce]:IS95:MODE FLINk18 | FLINk64 | RLINk | RLCoded

The command selects the operating mode.

FLINk18	Forward Link with 18 code channels
FLINk64	Forward Link with 64 code channels
RLINk	Reverse Link (from mobile station to base station)
RLCoded	Reverse Link Coded

Example: `:SOUR:IS95:MODE RLIN`

[:SOURce]:IS95:PRESet

The command sets all the following settings into a defined default state (as with to *RST). It can thus be guaranteed that a signal is generated at all and that it is in line with standard. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:IS95:PRES`

[:SOURce]:IS95:CRATe 1 kHz to 7 MHz

The command sets the chip rate.

Example: `:SOUR:IS95:CRAT 1.21 MHz` *RST value is 1.2288 MHz

[:SOURce]:IS95:FILTer

The commands for selecting a filter are under this node.

[:SOURce]:IS95:FILTer:FTYPe SCOSine I COSine I IS95 I EIS95

The command selects the type of filter for the Forward Link Mode (`IS95:FLINk18` or `IS95:FLINk64`).

SCOSine	Square root cosine (root Nyquist) filter
COSine	Cosine (Nyquist)-filter
IS95	Filter according to Interim Standard 95
EIS95	IS-95+EQUALIZER

Example: `:SOUR:IS95:FILT:FTYP COS` *RST value is IS95

[:SOURce]:IS95:FILTer:RTYPe SCOSine I COSine I IS95 I EIS95

The command selects the type of filter for the Reverse Link Mode.

SCOSine	Square root cosine (root Nyquist) filter
COSine	Cosine (Nyquist)-filter
IS95	Filter according to Interim Standard 95
EIS95	IS-95+EQUALIZER

Example: `:SOUR:IS95:FILT:RTYP COS` *RST value is IS95

[:SOURce]:IS95:FILTer:PARameter 0.1 to 0.7

The command sets the roll-off factor for the COS filters.

Example: `:SOUR:IS95:FILT:PAR 0.5` *RST value is 0.5

[:SOURce]:IS95:FILTer:MODE LACP I LEVM

This command selects one of the "L"ow filter modes.

Example: `:SOUR:IS95:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:IS95:LDIStortion[:STATe] ON I OFF

The command sets the reduced level for the low-distortion mode.

ON	Low-distortion mode
OFF	Normal level

Example: `:SOUR:IS95:LDIS ON` *RST value is OFF

[:SOURce]:IS95:SEQuence AUTO I RETRigger I AAUTo I ARETrigger

The command selects the trigger mode for the sequence..

AUTO	Continuously repeated
RETRigger	Continuously repeated; new start after a trigger
AAUTo	ARMED AUTO; waits for trigger, then switches over to AUTO and can no longer be triggered;
ARETrigger	ARMED RETRIG; a trigger event is required to start, each new trigger causes a restart

Example: `:SOUR:IS95:SEQ AAUT` *RST value is AUTO

[:SOURce]:IS95:TRIGger:SOURce EXTernal I INTernal

The command selects the trigger source. With INT selected, triggering is via remote control using the trigger command or via EXECUTE TRIGGER in case of manual control.

EXT	The trigger signal is fed in via input TRIGIN
INT	A start is only possible manually or via the remote control command `TRIG:DM:IMM`

Example: `:SOUR:IS95:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:IS95:TRIGger:INHibit 0 to 67108863

The command sets the retrigger inhibit duration (in number of chips).

Example: `:SOUR:IS95:TRIG:INH 1000` *RST value is 0

[:SOURce]:IS95:TRIGger:DELay 0 to 65535

The command defines the trigger delay (in number of chips).

Example: `:SOUR:IS95:TRIG:DEL 200` *RST value is 0

[:SOURce]:IS95:TRIGger:OUTPut[1]I2 TFRame I SSRollover I SFRame I ESECond I GATE

The command defines the output signal at trigger output 1 or 2. The following times can be selected:

TFRame	Traffic Frame/ 20 ms
SSRollover	Short Sequence Rollover 80/3 ms
SFRame	Super Frame 80 ms
ESECond	Even Second 2 s
GATE	GATE (PCG)

The indicated times apply to a chip rate of 1.2288 Mcps

Example: `:SOUR:IS95:TRIG:OUTP1 SFR` output1: *RST value is ESECond
output2: *RST value is SSRollover

[:SOURce]:IS95:TRIGger:OUTPut[1]I2:DELay -32768 to 32768

The command defines the delay of trigger signals in chips.

Example: `:SOUR:IS95:TRIG:OUTP2:DEL -50` *RST value is 0

[:SOURce]:IS95:TRIGger:OUTPut[1]I2:POLarity POSitive I NEGative

The commands defines the polarity of the signals at the trigger outputs.

Example: `:SOUR:IS95:TRIG:OUTP2:POL NEG` *RST value is POS

[:SOURce]:IS95:CLOCk

The commands for setting the chip clock are under this node.

[:SOURce]:IS95:CLOCk:MODE CHIP I CHIP4 I CHIP8 I CHIP16

The command sets the divider for the clock. With CHIP selected, the external clock is in the symbol mode, otherwise in the bit mode.

Example: `:SOUR:IS95:CLOC:MODE CHIP8` *RST value is CHIP

[:SOURce]:IS95:CLOCk:SOURce INTernal | EXTernal

The command selects the clock source.

INTernal	The internal clock generator is used and output via clock outputs SYMBOL CLOCK and BIT CLOCK.
EXTernal	The clock is fed externally via connector SYMBOL CLOCK.

Example: `:SOUR:IS95:CLOC:SOUR EXT` *RST value is INT

[:SOURce]:IS95:CLOCk:DELay 0 to 1.00

The command sets the delay of the chip clock with a high resolution.

Example: `:SOUR:IS95:CLOC:DEL 0.75` *RST value is 0

[:SOURce]:IS95:POWer?

The command queries the total power for the CDMA signal.

Example: `:SOUR:IS95:POW?`

[:SOURce]:IS95:POWer:ADJust

The command modifies the power of each active code channel. This means that the total power is set equal to the power in the level display. The command triggers an action and hence has no *RST value assigned.

Example: `:SOUR:IS95:POW:ADJ`

[:SOURce]:IS95:MAPPing

The command for storing and reading the complete channel assignments and settings are under this node. These mappings are not affected by *RST.

[:SOURce]:IS95:MAPPing:PREDefined:CATalog?

The command returns a list of all predefined mappings.

Example: `:SOUR:IS95:MAPP:PRED:CAT?`

[:SOURce]:IS95:MAPPing:PREDefined:LOAD 'name'

The command selects one of the predefined channel configurations (c.f. Chapter 2). This command triggers an event and hence has no *RST value.

Example: `:SOUR:IS95:MAPP:SEL 'PILOT'`

[:SOURce]:IS95:MAPPing:CATalog?

The command returns an enumerated list of all user-defined mappings.

Example: `:SOUR:IS95:MAPP:CAT?` Answer: `'test1','test2'`

[:SOURce]:IS95:MAPPing:LOAD 'name'

The command loads a user-defined channel assignment and setting (mapping). The name may have a maximum of 7 characters. This command triggers an action and hence has no *RST value.

Example: `:SOUR:IS95:MAPP:LOAD 'test'`

[:SOURce]:IS95:MAPPing:STORe 'name'

The command stores the current mapping under a name. The name may have a maximum of 7 characters. This command triggers an action and hence has no *RST value and no query.

Example: `:SOUR:IS95:MAPP:STOR 'test'`

[:SOURce]:IS95:MAPPing:DELete 'name'

The command deletes the indicated mapping. This command triggers an action and hence has no *RST value and no query.

Example: `:SOUR:IS95:MAPP:DEL 'test1'`

[:SOURce]:IS95:CHANnel<0 to 63>

The commands for specifying the channel configuration for the 18-channel Forward Link (channel 0 to 17) and 64-channel Forward Link (channel 0 to 63) are under this node. Channel 0 for which only the power can be set is the pilot channel.

[:SOURce]:IS95:CHANnel<1 to 17>:WALShcode 0 to 63

This command assigns a Walsh code to a channel. This applies to FLINk18 only; for FLINk64, the Walsh code corresponding to its channel number is assigned to every channel. The command is not available in this case.

Example: `:SOUR:IS95:CHAN2:WALS 23`

[:SOURce]:IS95:CHANnel<0 to 3>:POWer -30 dB to 0 dB

This command determines the power of a channel. For Flink18 the power for channels 0, 1 and 2 can be set separately. The power setting for channel 3 is also valid for the subsequent channels. For Flink64 the power setting for channel 1 is valid for all subsequent channels (except for the pilot channel)

Example: `:SOUR:IS95:CHAN2:POW -22 DB`

[:SOURce]:IS95:CHANnel<1 to 63>:DATA ZERO | ONE | ALTernate | PRBS

This command determines the data source of the channel.

ZERO	0000..., sequence of zeros
ONE	1111..., sequence of ones
ALT	1010..., alternating sequence, starting with 1
PRBS	Pseudo Random Bit sequence

Example: `:SOUR:IS95:CHAN2:DATA PRBS`

[:SOURce]:IS95:CHANnel<0 to 63>:STATe ON | OFF

The command switches the channel on or off.

Flink18: channels 0 to 8 are switched on and channels 9 to 17 are switched off.

Flink64: all channels are switched on.

Example: `:SOUR:IS95:CHAN17:STAT ON` *RST value: see text

[:SOURce]:IS95:RATE FULL | HALF

The command sets the data rate for operating mode Reverse Link (`IS95:MODE RLINK`).

Example: `:SOUR:IS95:RATE HALF` *RST value is FULL

[:SOURce]:IS95:RANDomizer[:STATe] ON | OFF

The command switches the burst randomizer for operating mode Reverse Link (`IS95:MODE RLINK`) on or off. The bursts are distributed at pseudo random within a 20-ms frame.

Example: `:SOUR:IS95:RAND ON` *RST value is OFF

[:SOURce]:IS95:DATA ZERO | ONE | ALTernate | PRBS | DLISt

This command determines the data source for operating mode Reverse Link (`IS95:MODE RLINK`).

ZERO	0000..., sequence of zeros
ONE	1111..., sequence of ones
ALT	1010..., alternating sequence, starting with 1
PRBS	Pseudo Random Bit Sequence
DLISt	The data list selected with `IS95:DLIS 'name'` is used.

Example: `:SOUR:IS95:DATA ZERO` *RST value is PRBS

[:SOURce]:IS95:DLISt 'name'

The command selects a data list. This list is used if `DLISt` is selected as the data source (`IS95:DATA DLIS`).

Example: `:SOUR:IS95:DLIS 'test'`

[:SOURce]:IS95:DLISt:CATalog?

The command queries the available data lists. (Only query, no *RST value)

Example: `:SOUR:IS95:DLIS:CAT?`

[:SOURce]:IS95:RLCoded:CTYPe TRAF14400 | TRAF7200 | TRAF3600 | TRAF1800 | ACC4800 | TRAF9600 | TRAF4800 | TRAF2400 | TRAF1200

The command defines the data rate and the channel type. It is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:CTYP TRAF1800` *RST value is TRAF14400

[:SOURce]:IS95:RLCoded:DATA PN9 | PN11| PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt

The command selects the data source. PN.. represent the PRBS generators, DLIS the data list selected with the following command. The command is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:DATA DLIS` *RST value is PN9

[:SOURce]:IS95:RLCoded:DLISt 'name'

The command selects a data list. This list is used if `DLISt` is selected as the data source. The command is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:DLIS 'test'`

[:SOURce]:IS95:RLCoded:FQINdicator ON | OFF

The command switches the frame quality indicator (a CRC of the data) on or off. If the frame quality indicator is switched off, only zeros are transmitted. The command is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:FQIN OFF` *RST value is ON

[:SOURce]:IS95:RLCoded:CENCoder ON | OFF

The command switches the convolutional encoder on or off. If the convolutional encoder is off, the required data rate is attained by repeating the symbols. The command is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:CENC OFF` *RST value is ON

[:SOURce]:IS95:RLCoded:BINTerleaver ON | OFF

The command selects the block interleaver function. It is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:BINT OFF` *RST value is ON

[:SOURce]:IS95:RLCoded:EBIT 0 | 1

The command sets the value of the erasure bit. It is only available with `'IS95:MODE RLCoded'` selected.

Example: `:SOUR:IS95:RLC:EBIT 0` *RST value is 1

3.5.11.11 SOURce:LIST Subsystem

This subsystem contains the commands for the LIST operating mode of the RF generator. The LIST mode is activated by command `SOURce:FREQuency:MODE LIST`. Processing the lists is controlled by the `TRIGger:LIST` subsystem. Each list consists of a FREQuency, POWer and DWELl content. The list contents must all be of the same length except for contents of length 1. This is interpreted as if the content had the same length as the other contents and all values were equal to the first value. After a list has been created and changed, command `:LIST:LEARn` has to be entered to have the settings transferred to the hardware.

Note: *SCPI designates the individual lists as segments.*

Command	Parameter	Default unit	Remark
[:SOURce]			
:LIST			
:CATalog?			Query only
:DELete	'Name of list'		
:ALL			
:DWELl	1ms to1 s {,1 ms to 1 s}	s	
:POINts?			Query only
:FREE?			
:FREQuency	300 kHz to RF$_{max}$ {, 300 kHz to RF$_{max}$ } | block data	Hz	RF$_{max}$: depends on model
:POINts?			Query only
:LEARn			No query
:MODE	AUTO | STEP		
:POWer	-144 to 16 dBm {, -144 to 16 dBm} | block data	dBm	
:POINts?			Query only
:SELect	'Name of list'		

[:SOURce]:LIST:CATalog?

The command requests a list of the lists available separated by commas. The command is a query and hence has no *RST value.

Example: `:SOUR:LIST:CAT?` Answer: `'MYLIST', 'LIST1', 'LIST2'`

[:SOURce]:LIST:DELete 'Name of list'

The command deletes the list indicated. *RST has no influence on data lists.

Example: `:SOUR:LIST:DEL 'LIST2'`

[:SOURce]:LIST:DELete:ALL

The command deletes all lists. As a possibly selected list is deleted as well, the LIST mode must be switched off (`SOURce:FREQuency:MODE CW` or `SWEep`). *RST has no influence on data lists.

Example: `:SOUR:LIST:DEL:ALL`

[:SOURce]:LIST:DWELl 1 ms to 1 s {, 1 ms to 1 s}

For every item of the FREQuency or POWer/VOLTage list contents, the command contains the time the instrument 'dwells' at this item.

Note: *The RF generator is not in a position to allocate different times to the individual items of the FREQuency and POWer list contents. Thus the DWELl part of the list should have length 1; the value is then valid for all items. If a list containing more than one element is indicated, all values must be equal.*

Example: `:SOUR:LIST:DWEL 0.15`

[:SOURce]:LIST:DWELl:POINts?

The command queries the length (in items) of the DWELl-part of the list. The command is a query and thus has no *RST value.

Example: `:SOUR:LIST:DWEL:POIN?` Answer: `1`

[:SOURce]:LIST:FREE?

The command queries two values. The first one indicates the space still vacant for lists (in items), the second one the space already occupied, also in items. The command is a query and thus has no *RST value.

Example: `:SOUR:LIST:FREE?` Answer: `2400, 200`

[:SOURce]:LIST:FREQuency 300 kHz to RF_{max} {, 300 kHz to RF_{max}} | block data
(RF_{max} depending on model)

The command fills the FREQuency part of the list selected with data. The data can either be indicated as a list of numbers (separated by commas) of arbitrary length or as binary block data. In the case of block data transmission, always 8 (4) bytes are interpreted as a floating-point number of double accuracy (cf. command `FORMat :DATA`). *RST does not influence data lists.

Example: `:SOUR:LIST:FREQ 1.4GHz, 1.3GHz, 1.2GHz,...`

[:SOURce]:LIST:FREQuency:POINts?

The command queries the length (in items) of the FREQuency part of the list presently selected. The command is a query and thus has no *RST value.

Example: `:SOUR:LIST:FREQ:POIN?` Answer: `327`

[:SOURce]:LIST:LEARn

The command learns the list selected. I.e., it determines the hardware setting for the entire list. The data thus determined are stored together with the list. The command triggers an event and thus has no *RST value.

Example: `:SOUR:LIST:LEAR`

Caution: *This command has to be given after every creating and changing of a list. The list must be learned as well after temperature changes or after calling internal calibration routines, as all parameters usually controlled are replaced by stored values in the LIST mode.*

[:SOURce]:LIST:MODE AUTO | STEP

The command indicates the mode in which the list is to be processed (by analogy with `SOURce:SWEep:MODE`).

AUTO	Each trigger event triggers a complete list run.
STEP	Each trigger event triggers only one step in processing the list.

Example: `:SOUR:LIST:MODE STEP` *RST value is AUTO

[:SOURce]:LIST:POWer -144 to 16 dBm {, -144 to 16 dBm} I block data

The command fills the LEVel part of the RF list selected with data. The data can either be indicated as a list of numbers (separated by commas) of arbitrary length or as binary block data. As to the format of the data, cf. command `:SOURce:LIST:FREQ`. *RST does not influence data lists.

Example: `:SOUR:LIST:POW 0dBm, -2dBm, -2dBm, -3dBm,...`

[:SOURce]:LIST:POWer:POINts?

The command queries the length (in items) of the LEVel part of the list presently selected. The command is a query and thus has no *RST value

Example: `:SOUR:LIST:POW:POIN?` Answer: `32`

[:SOURce]:LIST:SELect 'Name of list

The command selects the list indicated. If there is no list of this name, a new list is created. The name may contain up to 7 letters. The command triggers an event and thus has no *RST value

Example: `:SOUR:LIST:SEL 'LIST1'`

3.5.11.12 SOURce:MARKer Subsystem

This subsystem contains the commands to check the marker generation with sweeps. The SMIQ has three markers each for frequency and level sweeps which are differentiated by a numeric suffix after MARKer. The settings for frequency sweep and level sweep marker are independent of each other.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:MARKer1|2|3			
[:FSWeep]			
:AMPLitude	ON | OFF		
:AOFF			No query
:FREQuency	300 kHz to RF$_{max}$	Hz	RF$_{max}$ depending on model
[:STATe]	ON | OFF		
:PSWeep			
:AOFF			No query
:POWer	-144 to+16 dBm	dBm	
[:STATe]	ON | OFF		
:POLarity	NORMal | INVerted		

[:SOURce]:MARKer1|2|3[:FSWeep]

The commands for the markers with frequency sweep are under this node. Keyword :FSWeep can be omitted, then the command conforms to SCPI regulations.

[:SOURce]:MARKer1|2|3[:FSWeep]:AMPLitude ON | OFF

The command specifies whether the marker influences the signal level.

ON	The output level is reduced by a constant value when the marker frequency is executed.
OFF	The output level remains unchanged. *RST value is OFF
Example:	`:SOUR:MARK1:FSW:AMP ON`

[:SOURce]:MARKer1|2|3[:FSWeep]:AOFF

Command (All markers off) switches off all frequency markers. This command triggers an event, thus it has no *RST value and no query form.

Example: `:SOUR:MARK:FSW:AOFF`

[:SOURce]:MARKer1|2|3[:FSWeep]:FREQuency 300 kHz to RF$_{max}$ (RF$_{max}$ depending on model)

The command sets the marker selected by the numeric suffix with MARKer to the frequency indicated.

In this command, the OFFSet value of the subsystem (menu) FREQuency is considered as with input value MARKER in the SWEEP-FREQ menu. Thus the specified range indicated is only valid for `SOURce:FREQuency:OFFSet` = 0. The specified range with other OFFSet values can be calculated according to the following formula (cf. Chapter 2, Section "Frequency Offset", as well):

300 kHz - OFFSet to 2.2/3.3 GHz - OFFSet

*RST value for MARK1: 100 MHz
MARK2: 200 MHz
MARK3: 300 MHz

Example: `:SOUR:MARK1:FSW:FREQ 30MHz`

[:SOURce]:MARKer1|2|3[:FSWeep][:STATe] ON | OFF

The command switches the marker selected by the numeric suffix with MARKer on or off.

Example: `:SOUR:MARK1:FSW:STAT ON` *RST value is OFF

[:SOURce]:MARKer1|2|3:PSWeep

The commands for the markers with level sweep are under this node (Power sweep). The three markers are differentiated by a numeric suffix after MARKer.

[:SOURce]:MARKer1|2|3:PSWeep:AOFF

The command switches all level markers off. This command is an event and thus has no *RST value and no query form.

Example: `:SOUR:MARK:PSW:AOFF`

[:SOURce]:MARKer1|2|3:PSWeep:POWer -144 dBm to +16 dBm

The command sets the marker selected by the numeric suffix with MARKer to the level indicated.

In this command, the OFFSet value of subsystem (menu) POWER (LEVEL) is considered in correspondence with input value MARKER in the SWEEP LEVEL menu. Thus the specified range indicated is only valid for `SOURce:POWer:OFFSet = 0`. The specified range with other OFFSet values can be calculated according to the following formula (cf. Chapter 2, Section "Level Offset" as well):

-144 dBm OFFSet to 16 dBm OFFSet *RST value for MARK1: 1 dBm
MARK2: 2 dBm
Example: `:SOUR:MARK1:PSW:POW -2dBm` MARK3: 3 dBm

[:SOURce]:MARKer1|2|3:PSWeep[:STATe] ON | OFF

The command switches the marker selected by the numeric suffix with MARKer on or off.

Example: `:SOUR:MARK1:PSW:STAT ON` *RST value is OFF

[:SOURce]:MARKer1|2|3:POLarity NORMal | INVerted

The command specifies the polarity of the marker signal.

NORMal When running through the marker condition, TTL level is applied at the marker output, otherwise 0 V.

INVerted When running through the marker condition, 0 V is applied at the marker output, otherwise TTL level. *RST value is NORM

Example: `:SOUR:MARK:POL INV`

3.5.11.13 SOURce:NADC Subsystem (Digital Standard)

Note *#H0 to #HF are characters which are entered in alphanumeric Hex form manually. SCPI (and IEEE 488.2) also accept the entry of non-decimal characters in octal and binary such as*
#H|h <0 to 9, A|a to F|f>,
#Q|q <0 to 7> and
#B|b <0|1>.
The characters are always output in Hex format after a query.

Command	Parameter	Default unit	Remark
[:SOURce]			
:NADC			
:STATe	ON | OFF		
:STANdard	-		No query
:SRATe	1kHz to 200 kHz	Hz	
:FILTer			
:TYPE	SCOSine | COSine		
:PARameter	0.1 to 0.7		
:MODE	LACP | LEVM		
:LDIStortion			
[:STATe]	ON | OFF		
:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger		
:TRIGger			
:SOURce	EXTernal | INTernal		
:INHibit	0 to 67.1E6		
:DELay	0 to 65535		
:OUTPut[2]			
:DELay	0 to 971		
:PERiod	1 to 67.1E6		
:CLOCk			
:SOURce	INTernal | EXTernal		
:MODE	BIT | SYMBol		
:DELay	0 to 1.0		
:PRAMp			
:PRESet			no query
:TIME	0.25 to 16		
:DELay	-1,0 to +1,0		
:SHAPe	LINear | COSine		
:ROFFset	-9 to +9		
:FOFFset	-9 to +9		
:SLOT			
:ATTenuation	0 to 70 dB	dB	
:LINK	UP | DOWN		
:RCONfiguration	AHALf | FULL1 | FULL2 | FULL3 | FULL12 | FULL13 | FULL23 | AFULl		

Command	Parameter	Default unit	Remark
[:SOURce]			
:NADC			
:FLISt			
:PREDefined			
:CATalog?	⇒ name {,name}...		query only
:LOAD	'name'		
:CATalog?	⇒ name {,name}...		query only
:LOAD	'name'		
:STORe	'name'		no query
:DELete	'name'		no query
:DLISt			
:CAtalog?	⇒ name {,name}...		query only
:SLOT<i>			i=[1],2 to 8 (Slot Selector)
:TYPE	TCH | SHORt | ADATa		
:LEVel	OFF | ATT | FULL		no query
:PRESet	-		
[:SOURce]			
:SACChannel	PN9 | PN11| PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:DATA	PN9 | PN11| PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:SYNC	#H0 to #HFFFFFFF (28 bit)		
:CDVCc	#H1 to #HFFF (8 bit)		
:RSVD	#H800 to #HFFF (12/11 bit)		

[:SOURce]:NADC:STATe ON | OFF

The command switches the modulation on according to NADC standard. All other standards that might be switched on or digital modulation are automatically switched OFF.

Example: `:SOUR:NADC:STAT ON` *RST value is OFF

[:SOURce]:NADC:STANdard

The commands sets all modulation parameters to the values of the NADC standard. I.e., all values that have been selected by the `:NADC:SLOT...` commands described in the following are not valid. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:NADC:STAN`

[:SOURce]:NADC:SRATe 1kHz to 200 kHz

The command sets the symbol rate.

Example: `:SOUR:NADC:SRAT 192.1 kHz` *RST value is 192 kHz

[:SOURce]:NADC:FILTer

The commands for selecting a filter are under this node.

[:SOURce]:NADC:FILTer:TYPE SCOSine|COSine

The command selects the type of filter.

Example: `:SOUR:NADC:FILT:TYPE COS` *RST value is SCOS

[:SOURce]:NADC:FILTer:PARameter 0.1 to 0.7

The command sets the filter parameter entry (Roll Off factor).

Example: `:SOUR:NADC:FILT:PAR 0.5` *RST value is 0.35

[:SOURce]:NADC:FILTer:MODE LACP | LEVM

This command selects one of the "L"ow filter modes.

Example: `:SOUR:NADC:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:NADC:LDIStortion[:STATe] ON | OFF

The command sets the reduced level for the low-distortion mode.

Example: `:SOUR:NADC:LDIS ON` *RST value is OFF

[:SOURce]:NADC:SEQuence AUTO | RETRigger | AAUTo | ARETrigger

The command selects the trigger mode for the sequence.

AAUTo is	ARMED AUTO
ARETrigger is	ARMED RETRIG

Example: `:SOUR:NADC:SEQ AAUT` *RST value is AUTO

[:SOURce]:NADC:TRIGger:SOURce EXTernal | INTernal

The command selects the trigger source. With INT selected, triggering is via IEC/IEEE bus or the Execute command in manual control.

Example: `:SOUR:NADC:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:NADC:TRIGger:INHibit 0 to 67.1E6

The command sets the retrigger inhibit duration (in number of symbols).

Example: `:SOUR:NADC:TRIG:INH 1000` *RST value is 0

[:SOURce]:NADC:TRIGger:DELay 0 to 65535

The command sets the trigger delay (in number of symbols).

Example: `:SOUR:NADC:TRIG:DEL 200` *RST value is 0

[:SOURce]:NADC:TRIGgerOUTPut[2]:DELay 0 to 971

The command determines the delay of the signal at trigger output 2 in comparison with the start of the frames in number of symbols.

Example: `:SOUR:NADC:TRIG:OUTP2:DEL 16` *RST value is 0

[:SOURce]:NADC:TRIGger:OUTPut[2]:PERiod 1 to 67.1E6

The command sets the repeat rate (in number of frames) of the signal at trigger output 2.

Example: `:SOUR:NADC:TRIG:OUTP:PER 8` *RST value is 1

[:SOURce]:NADC:CLOCk

The commands for setting the data clock are under this node.

[:SOURce]:NADC:CLOCk:SOURce INTernal | EXTernal

The command selects the source for the DM data clock.

INTernal	The internal clock generator is used and output via the clock outputs of the serial and parallel interface.
EXTernal	The clock is externally fed in via the serial interface and output via the parallel interface.

Example: `:SOUR:NADC:CLOC:SOUR INT` *RST value is INT

[:SOURce]:NADC:CLOCk:MODE BIT | SYMBol

The command sets the clock mode for `:NADC:CLOCk:SOURce EXTernal`.

BIT	The external clock has to be a bit clock.
SYMBol	The external clock has to be a symbol clock.

The bit and symbol clock only differ for this modulation, because it has more than two states, ie more than one bit is required to code each state.

Example: `:SOUR:NADC:CLOC:MODE BIT` *RST value is SYMB

[:SOURce]:NADC:CLOCk:DELay 0 to 1.0

The command sets the delay of the symbol clock (as a fraction of the length of a symbol).

Example: `:SOUR:NADC:CLOC:DEL 0.75` *RST value is 0

[:SOURce]:NADC:PRAMp

The commands for the level control of the burst are under this node.

[:SOURce]:NADC:PRAMp:PRESet

This command sets the standard-stipulated values for the following commands of level control. It is an event and hence has no query and no *RST value.

Example: `:SOUR:NADC:PRAM:PRES`

[:SOURce]:NADC:PRAMp:TIME 0.25 to 16.0

The command sets the cutoff steepness (in symbol clocks).

Example: `:SOUR:NADC:PRAM:TIME 2.5` *RST value is 3

[:SOURce]:NADC:PRAMp:DELay -1.0 to + 1.0

The command defines the shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope.

Example: `:SOUR:NADC:PRAM:DEL 0.2` *RST value is 0

[:SOURce]:NADC:PRAMp:SHAPe LINear | COSine

The command selects the linear or cosine shape of the ramp-up and ramp-down (power burst).

Example: `:SOUR:NADC:PRAM:SHAP COS` *RST value is COS

[:SOURce]:NADC:PRAMp:ROFFset -9 to +9

The command determines the timing of the ('R'ising) edge of a power burst to the beginning of the block.

Example: `:SOUR:NADC:PRAM:ROFF -3` *RST value is 0

[:SOURce]:NADC:PRAMp:FOFFset -9 to +9

The command determines the timing of the ('F'alling) edge of a power burst to the data block

Example: `:SOUR:NADC:PRAM:FOFF 4` *RST value is 0

[:SOURce]:NADC:SLOT:ATTenuation 0 to -70 dB

The command determines the amount by which the power of the slots marked by `:NADC:SLOT:LEVEL ATT` is reduced in comparison with the normal output power (Attribut to `:LEVEL FULL`).

Example: `:SOUR:NADC:SLOT:ATT 20 dB` *RST value is 0

[:SOURce]:NADC:LINK UP | DOWN

The command determines the burst type which differs depending on the transmit direction. The structure of the frames is different and thus has an effect on the selection of possible `:NADC:SLOT` commands. This command is stored as a part of the `:NADC:FLISt` configurations described below.

UP	From mobile part to fixed part
DOWN	From fixed part to mobile part

Example: `:SOUR:NADC:LINK DOWN` *RST value is DOWN

[:SOURce]:NADC:RCONfiguration AHALf | FULL1 | FULL2 | FULL3 | FULL12 | FULL13 | FULL23 | AFUL

This configuration setup determines how the FULL- and HALF-rate channels (slots) are distributed among the frames. This command is stored as a part of the :NADC:FLISt configurations described below.

AHALf	All Half
FULL1	FULL (1 & 4)
FULL2	FULL (2 & 5)
FULL3	FULL (3 & 6)
FULL12	FULL (1 & 4), (2 & 5)
FULL13	FULL (1 & 3), (3 & 6)
FULL23	FULL (2 & 5), (3 & 6)
AFUL	All Full

Example: `:SOUR:NADC:RCON FULL3` *RST value is AFUL

[:SOURce]:NADC:FLISt

The commands for storing and reading complete frames including their bursts (slots) are under this node. Predefined and user-generated frames have to be distinguished.

[:SOURce]:NADC:FLISt:PREDefined:CATalog?

The command returns a list of all predefined frames.

Example: `:SOUR:NADC:FLIS:PRED:CAT?`

[:SOURce]:NADC:FLISt:PREDefined:LOAD 'name'

The command selects one of the predefined (fixed) frames (c.f. Chapter 2). This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:NADC:FLIS:PRED:LOAD 'test'`

[:SOURce]:NADC:FLISt:CATalog? ⇒name, {name}...

The command returns a list of all user-defined frames.

Example: `:SOUR:NADC:FLIS:CAT?`

[:SOURce]:NADC:FLISt:LOAD 'name'

The command loads a user-defined frame. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:NADC:FLIS:LOAD 'dn_tch'`

[:SOURce]:NADC:FLISt:STORe 'name'

The command stores the current frame under a name. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:NADC:FLIS:STOR 'test'`

[:SOURce]:NADC:FLISt:DELete 'name'

The command deletes the indicated frame. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:NADC:FLIS:DEL 'test1'`

[:SOURce]:NADC:DLISt:CATalog?

The command returns an enumeration of all data lists.

These data lists are selected by means of `:NADC:SLOT:SACC:DLIS 'name'` and`...:DATA:DLIS 'name'` and used if `:NADC:SLOT:SACC DLISt` and`...:DATA DLISt` are set.

Example: `:SOUR:NADC:DLIS:CAT?`

[:SOURce]:NADC:SLOT<i>

The commands for setting the slot characteristics are under this node. Since a frame contains 6 slots, suffix 'i' is used to select the slot to be changed. i = [1] | 2 | 3 | 3 | 5 | 6

[:SOURce]:NADC:SLOT<i>:TYPE TCH | SHORt | ADATa

The command selects the type of burst (slot) defined in the standard.

TCH	Normal communication channel with the fields defined by the standard.
ADATa	All data (without predefined SYNC, SACCh, CDVCc and RSVD fields)
SHORt	Only used for uplink to set up TCH.

Example: `:SOUR:NADC:SLOT2:TYPE TCH` *RST value is TCH

[:SOURce]:NADC:SLOT<i>:LEVel OFF | ATT | FULL

The command determines the power stage of the slot.

OFF	The slot is inactive. For UPLINK, the source is always at full power. Therefore, in the case of an DOWNLINK TCH burst, only a series of 1's is sent instead of the data.
ATT	The power is reduced by the amount defined by `:NADC:SLOT:ATT` For an DOWNLINK TCH burst this setting is not valid.
FULL	Full power (predefined by level setting)

Example: `:SOUR:NADC:SLOT2:LEV ATT` *RST value is FULL

[:SOURce]:NADC:SLOT<i>:PRESet

The command sets all the parameters of the slot to the values defined by the standard as a function of the type set above and the direction (LINK). This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:NADC:SLOT2:PRES`

[:SOURce]:NADC:SLOT<i>[:SOURce]

The commands for determining the source for the data contents are under this node. The source is either a PRBS generator (with different sequence length), the data input SER DATA or a data list.

Selection of data source for the data fields of the burst:

PN9 to 23	PRBS generator has been selected
DLISt	Data of a programmable data list
SDATa	Data from data input SER DATA

[:SOURce]:NADC:SLOT<i>[:SOURce]:SACChannel PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the data words.

Example: `:NADC:SLOT3:SACC PN15` *RST value is PN9

[:SOURce]:NADC:SLOT<i>[:SOURce]:SACChannel:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:NADC:SLOT:SACC DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:NADC:SLOT:SACC:DLIS 'test'`

[:SOURce]:NADC:SLOT<i>[:SOURce]:DATA PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the data words.

Example: `:SOUR:NADC:SLOT2:DATA DLIS` *RST value is PN9

[:SOURce]:NADC:SLOT<i>[:SOURce]:DATA:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:NADC:SLOT:DATA DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:NADC:SLOT:DATA:DLIS 'test'`

[:SOURce]:NADC:SLOT<i>:SYNC #H0 to #HFFFFFFF (28 bit)

The command changes the sync word predefined by the standard.

Example: `:SOUR:NADC:SLOT2:SYNC #HC7E3C0C` *RST value depends on `SLOT:TYPE`

[:SOURce]:NADC:SLOT<i>:CDVCc #H1 to #HFFF (8 bit)

This command sets the Coded Digital Verification Color Code.

Example: `:SOUR:NADC:SLOT2:CDVCc #H3F` *RST value is 1

[:SOURce]:NADC:SLOT<i>:RSVD #H800 to #HFFF (12/11 bit)

The command sets the reserved word (only for TCH and LINK DOWN). The MSBit is normally set.

Example: `:SOUR:NADC:SLOT2:RSVD #H80F` *RST value is #H800

3.5.11.14 SOURce:NOISe Subsystem

Subsystem NOISe comprises all commands for setting the noise generator.
The NDSim subsystem under CALibrate is available for the offset calibration. In the DIAGnostic subsystem the noise or carrier signal can be switched off for C/N measurements (refer to chapter Performance Test in the Operating Manual).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:NOISe			Not-SCPI
[:STATe]	ON I OFF		
:SNRatio	-5.0 to 30.0	dB	
:BANDwidth|BWIDth	10k to 10M	Hz	

[:SOURce]:NOISe[:STATe] ON I OFF

This command switches White Gaussian Noise on or off.

Example: `:SOUR:NOIS ON` *RST value is OFF

[:SOURce]:NOISe:SNRatio -5.0 to 30.0 dB

This command sets the S/N ratio.

Setting range is -5 dB to +30 dB, resolution is 0.1 dB.

Example: `:SOUR:NOIS:SNR 10 DB` *RST value is 0 dB

[:SOURce]:NOISe:BANDwidth|BWIDth 10000 to 10000000 Hz

This command sets the noise bandwidth. Setting range is 10 kHz to 10 MHz.

Example: `:SOUR:NOIS:BAND 1.23 MHZ` *RST value is 10 kHz

3.5.11.15 SOURce:PDC Subsystem (Digital Standard)

Note: *#H0 to #HF are characters which are entered in alphanumeric Hex form manually. SCPI (and IEEE 488.2) also accept the entry of non-numeric characters in octal and binary such as*
#H|h <0 to 9, A|a to F|f>,
#Q|q <0 to 7> and
#B|b <0|1>.
The characters are always output in Hex format after a query.

Command	Parameter	Default unit	Remark
[:SOURce]			
:PDC			
:STATe	ON | OFF		
:STANdard			No query
:SRATe	1kHz to 200 kHz	Hz	
:FILTer			
:TYPE	SCOSine | COSine		
:PARameter	0.1 to 0.7		
:MODE	LACP | LEVM		
:LDIStortion			
[:STATe]	ON | OFF		
:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger		
:TRIGger			
:SOURce	EXTernal | INTernal		
:INHibit	0 to 67.1E6		
:DELay	0 to 65535		
:OUTPut[2]			
:DELay	0 to 839		
:PERiod	1 to 67.1E6		
:CLOCk			
:SOURce	INTernal | EXTernal		
:MODE	BIT | SYMBol		
:DELay	0 to 1.0		
:PRAMp			
:PRES			no query
:TIME	0.25 to 16		
:DELay	-1.o to 1.0		
:SHAPe	LINear | COSine		
:ROFFset	-9 to +9		
:FOFFset	-9 to +9		
:SLOT			
:ATTenuation	0 to 70 dB	dB	
:LINK	UP | DOWN		
:RCONfiguration	AHALf | FULL0 | FULL1 | FULL2 | FULL10 | FULL20 | FULL21 | AFUL		

Command	Parameter	Default unit	Remark
[:SOURce]			
:PDC			
:FLISt			
:PREDefined			
:CATalog?			query only
:LOAD	'name'		
:CATalog?			query only
:LOAD	'name'		
:STORe	'name'		no query
:DELete	'name'		no query
:DLISt			
:CATalog?			query only
:SLOT<i>			
:TYPE	TCH | SYNC | VOX | ADATa		
:LEVel	OFF | ATT | FULL		
:PRESet			No query
:SCRamble			
:STATe	ON | OFF		
:STARt	#H1 to #H1FF (9 bits)		
:SFRame			
:STATe	ON | OFF		
:RCHPosition	1 to 17		
[:SOURce]			
:DATA	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:SACChannel	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:RCHannel	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:SI	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:PREamble	#H0 to #HFF... (2/6/48/102 bits)		
:SYNC	#H0 to #HFF... (20/32 bits)		
:SYNC2	#H0 to #HFF... (20/32 bits)		
:CCODe	#H0 to #HFF (8 bits)		
:POSTamble	#H0 to #H3FF... (78 bits)		
:SF	0 | 1		

[:SOURce]:PDC:STATe ON | OFF

The command switches the modulation on according to PDC standard. All other standards that might be switched on or digital modulation are automatically switched OFF.

Example: `:SOUR:PDC:STAT ON` *RST value is OFF

[:SOURce]:PDC:STANdard

The commands sets all modulation parameters to the values of the PDC standard. I.e., all values that have been selected by the `:PDC:SLOT...` commands described in the following are not valid. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PDC:STAN`

[:SOURce]:PDC:SRATe 1kHz to 200 kHz

The command sets the symbol rate.

Example: `:SOUR:PDC:SRAT 21.1 kHz` *RST value is 21.0 kHz

[:SOURce]:PDC:FILTer

The commands for selecting a filter are under this node.

[:SOURce]:PDC:FILTer:TYPE SCOSine|COSine

The command selects the type of filter.

Example: `:SOUR:PDC:FILT:TYPE COS` *RST value is SCOS

[:SOURce]:PDC:FILTer:PARameter 0.1 to 0.7

The command sets the filter parameter entry (Roll Off factor).

Example: `:SOUR:PDC:FILT:PAR 0.51` *RST value is 0.5

[:SOURce]:PDC:FILTer:MODE LACP | LEVM

This command selects one of the "L"ow filter modes.

Example: `:SOUR:PDC:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:PDC:LDIStortion[:STATe] ON | OFF

The command sets the reduced level for the low-distortion mode.

Example: `:SOUR:PDC:LDIS ON` *RST value is OFF

[:SOURce]:PDC:SEQuence AUTO | RETRigger | AAUTo | ARETrigger

The command selects the trigger mode for the sequence.

AAUTo is	ARMED AUTO
ARETrigger is	ARMED RETRIG

Example: `:SOUR:PDC:SEQ AAUT` *RST value is AUTO

[:SOURce]:PDC:TRIGger:SOURce EXTernal | INTernal

The command selects the trigger source. With INT selected, triggering is via IEC/IEEE bus or the Execute command in manual control.

Example: `:SOUR:PDC:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:PDC:TRIGger:INHibit 0 to 67.1E6

The command sets the retrigger inhibit duration (in number of symbols).

Example: `:SOUR:PDC:TRIG:INH 1000` *RST value is 0

[:SOURce]:PDC:TRIGger:DELay 0 to 65535

The command sets the trigger delay (in number of symbols).

Example: `:SOUR:PDC:TRIG:DEL 200` *RST value is 0

[:SOURce]:PDC:TRIGgerOUTPut[2]:DELay 0 to 839

The command determines the delay of the signal at trigger output 2 in comparison with the start of the frames in number of symbols.

Example: `:SOUR:PDC:TRIG:OUTP2:DEL 16` *RST value is 0

[:SOURce]:PDC:TRIGger:OUTPut[2]:PERiod 1 to 67.1E6

The command sets the repeat rate (in number of frames) of the signal at trigger output 2.

Example: `:SOUR:PDC:TRIG:OUTP:PER 8` *RST value is 1

[:SOURce]:PDC:CLOCk

The commands for setting the data clock are under this node.

[:SOURce]:PDC:CLOCk:SOURce INTernal | EXTernal

The command selects the source for the DM data clock.

INTernal	The internal clock generator is used and output via the clock outputs of the serial and parallel interface.
EXTernal	The clock is externally fed in via the serial interface and output via the parallel interface.

Example: `:SOUR:PDC:CLOC:SOUR INT` *RST value is INT

[:SOURce]:PDC:CLOCk:MODE BIT | SYMBol

The command sets the clock mode for `:PDC:CLOCk:SOURce EXTernal`.

BIT	The external clock has to be a bit clock.
SYMBol	The external clock has to be a symbol clock.

The bit and symbol clock only differ for modulations with more than two states, ie modulations for which more than one bit is required to code each state.

Example: `:SOUR:PDC:CLOC:MODE BIT` *RST value is SYMB

[:SOURce]:PDC:CLOCk:DELay 0 to 1.0

The command sets the delay of the symbol clock (as a fraction of the length of a symbol).

Example: `:SOUR:PDC:CLOC:DEL 0.75` *RST value is 0

[:SOURce]:PDC:PRAMp

The commands for the level control of the burst are under this node.

[:SOURce]:PDC:PRAMp:PRESet

This command sets the standard-stipulated values for the following commands of level control. It is an event and hence has no query and no *RST value.

Example: `:SOUR:PDC:PRAM:PRES`

[:SOURce]:PDC:PRAMp:TIME 0.25 to 16.0

The command sets the cutoff steepness (in symbol clocks).

Example: `:SOUR:PDC:PRAM:TIME 2.5` *RST value is 2

[:SOURce]:PDC:PRAMp:DELay -1.0 to + 1.0

The command defines the shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope.

Example: `:SOUR:PDC:PRAM:DEL 0.2` *RST value is 0

[:SOURce]:PDC:PRAMp:SHAPe LINear | COSine

The command selects the linear or cosine shape of the ramp-up and ramp-down (power burst).

Example: `:SOUR:PDC:PRAM:SHAP COS` *RST value is COS

[:SOURce]:PDC:PRAMp:ROFFset -9 to +9

The command determines the timing of the ('R'ising) edge of a power burst to the beginning of the block.

Example: `:SOUR:PDC:PRAM:ROFF -3` *RST value is 0

[:SOURce]:PDC:PRAMp:FOFFset -9 to +9

The command determines the timing of the ('F'alling) edge of a power burst to the data block

Example: `:SOUR:PDC:PRAM:FOFF 4` *RST value is 0

[:SOURce]:PDC:SLOT:ATTenuation 0 to 70 dB

The command determines the amount by which the power of the slots marked by `:PDC:SLOT:LEVEL ATT` is reduced in comparison with the normal output power (Attribut to `:LEVEL FULL`).

Example: `:SOUR:PDC:SLOT:ATT 20 dB` *RST value is 0

[:SOURce]:PDC:LINK UP | DOWN

The command determines the burst type which differs depending on the transmit direction. The structure of the frames is different and thus has an effect on the selection of possible `:PDC:SLOT` commands. This command is stored as a part of the `:PDC:FLISt` configurations described below.

UP	From mobile part to fixed part
DOWN	From fixed part to mobile part

Example: `:SOUR:PDC:LINK DOWN` *RST value is DOWN

[:SOURce]:PDC:RCONfiguration AHALf | FULL1 | FULL2 | FULL3 | FULL12 | FULL13 | FULL23 | AFUL

This configuration setup determines how the FULL- and HALF-rate channels (slots) are distributed among the frames. This command is stored as a part of the :PDC:FLISt configurations described below.

AHALf	All Half
FULL0	FULL (0 & 3)
FULL1	FULL (1 & 4)
FULL2	FULL (2 & 5)
FULL10	FULL (1 & 4), (0 & 3)
FULL20	FULL (2 & 5), (0 & 3)
FULL21	FULL (2 & 5), (1 & 4)
AFUL	All Full

Example: `:SOUR:PDC:RCON FULL0` *RST value is AFUL

[:SOURce]:PDC:FLISt

The commands for storing and reading complete frames including their bursts (slots) are under this node. Predefined and user-generated frames have to be distinguished.

[:SOURce]:PDC:FLISt:PREDefined:CATalog?

The command returns a list of all predefined frames.

Example: `:SOUR:PDC:FLIS:PRED:CAT?`

[:SOURce]:PDC:FLISt:PREDefined:LOAD 'name'

The command selects one of the predefined (fixed) frames (c.f. CHapter 2) . This command triggers an event and hence has no *RST value.

Example: `:SOUR:PDC:FLIS:PRED:LOAD 'dn_tch'`

[:SOURce]:PDC:FLISt:CATalog?

The command returns a list of all user-defined frames.

Example: `:SOUR:PDC:FLIS:CAT?`

[:SOURce]:PDC:FLISt:LOAD 'name'

The command loads a user-defined frame. This command triggers an event and hence has no *RST value.

Example: `:SOUR:PDC:FLIS:LOAD 'test'`

[:SOURce]:PDC:FLISt:STORe 'name'

The command stores the current frame under a name. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PDC:FLIS:STOR 'test'`

[:SOURce]:PDC:FLISt:DELete 'name'

The command deletes the indicated frame. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PDC:FLIS:DEL 'test1'`

[:SOURce]:PDC:DLISt:CATalog?

The command returns an enumeration of all data lists.

These data lists are selected by means of `:PDC:SLOT:SACC:DLIS`, `..:RCH:DLIS`, `...SI:DLIS`, or `...:DATA:DLIS 'name'` and used if `:PDC:SLOT:SACC`, `...RCH`, `SI`, or `...:DATA DLISt` are set.

Example: `:SOUR:PDC:DLIS:CAT?`

[:SOURce]:PDC:SLOT<i>

The commands for setting the slot characteristics are under this node. Since a frame contains 8 slots, suffix 'i' is used to select the slot to be changed. i = 0 | [1] | 2 | 3 | 3 | 5 | 6 | 7

[:SOURce]:PDC:SLOT<i>:TYPE TCH | SYNC | VOX | ADATa

The command selects the type of burst (slot) defined in the standard.

ADATa is All Data

Example: `:SOUR:PDC:SLOT2:TYPE TCH` *RST value is TCH

[:SOURce]:PDC:SLOT<i>:LEVel OFF | ATT | FULL

The command determines the power stage of the slot.

OFF	The slot is inactive For UPLINK, the source is always at full power. Therefore, in the case of an DOWNLINK TCH burst, only a series of 1's is sent instead of the data.
ATT	The power is reduced by the amount defined by `:PDC:SLOT:ATT` For an DOWNLINK TCH burst this setting is not valid.
FULL	Full power (predefined by level setting)

Example: `:SOUR:PDC:SLOT2:LEV ATT` *RST value is FULL

[:SOURce]:PDC:SLOT<i>:PRESet

The command sets all the parameters of the slot to the values defined by the standard as a function of the type set above. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PDC:SLOT2:PRES`

[:SOURce]:PDC:SLOT<i>:SCRamble

The commands for setting the scramble method are under this node.

[:SOURce]:PDC:SLOT<i>:SCRamble:STATe ON | OFF

The command switches scrambling for data fields DATA, SI and SACCH on or off.

Example: `:SOUR:PDC:SLOT2:SCR:STAT ON` *RST value is OFF

[:SOURce]:PDC:SLOT<i>:SCRamble:STARt #H1 to #H1FF (9 bits)

The command sets the start value for the scramble sequence.

Example: `:SOUR:PDC:SLOT2:SCR:STAR #H12` *RST value is 1

[:SOURce]:PDC:SLOT<i>:SFRame:STATe ON | OFF

This command switches the superframe on or off. When switched on, RCD data will be inserted instead of SACCH data in some slots and SYNC2 will be used instead of SYNC in the first slot of the superframe.

Example: `:SOUR:PDC:SLOT2:SFR:STAT ON` *RST value is OFF

[:SOURce]:PDC:SLOT<i>:SFRame:RCHPosition 1 to 17

The command determines the position of the second RCH.

Example: `:SOUR:PDC:SLOT2:SFR:RCHP 10` *RST value is 1

[:SOURce]:PDC:SLOT<i>[:SOURce]

The commands for determining the source for the data contents are under this node. The source is either a PRBS generator (with different sequence length), the data input SER DATA or a data list.

Selection of data source for the data fields of the burst:

PN9 to 23	PRBS generator has been selected
DLISt	Data from a programmable data list
SDATa	Data from data input SER DATA

[:SOURce]:PDC:SLOT<i>[:SOURce]:DATA PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the data words.

Example: `:SOUR:PDC:SLOT3:DATA PN15` *RST value is PN9

[:SOURce]:PDC:SLOT<i>[:SOURce]:DATA:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:PDC:SLOT:DATA DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:SOUR:PDC:SLOT:DATA:DLIS 'test'`

[:SOURce]:PDC:SLOT<i>[:SOURce]:SACChannel PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the slow associated control channel (for `:SLOT:TYPE TCH...` and `VOX`).

Example: `:SOUR:PDC:SLOT3:SACC PN15` *RST value is PN9

[:SOURce]:PDC:SLOT<i>[:SOURce]:SACChannel:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:SOUR::PDC:SOUR:SLOT:SACC DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:SOUR:PDC:SLOT:SACC:DLIS 'test'`

[:SOURce]:PDC:SLOT<i>[:SOURce]:RCHannel PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the housekeeping channel (for `:SLOT:FRAMe:STATe ON`).

Example: `:SOUR:PDC:SLOT2:RCH DLIS` *RST value is PN9

[:SOURce]:PDC:SLOT<i>[:SOURce]:RCHannel:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:SOUR:PDC:SLOT:RCH DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:PDC:SLOT:RCH:DLIS 'test'`

[:SOURce]:PDC:SLOT<i>[:SOURce]:SI PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the sync information field (for `:SLOT:TYPE SYNC`).

Example: `:SOUR:PDC:SLOT2:SI DLIS` *RST value is PN9

[:SOURce]:PDC:SLOT<i>[:SOURce]:SI:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:SOUR:PDC:SLOT:SI DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:SOUR:PDC:SLOT:SI:DLIS 'test'`

[:SOURce]:PDC:SLOT<i>:PREamble #H0 to #H... (2/6/48/102 bits)

The command sets the value of the 'P' bits. The length and the *RST value depend on the slot type and the link direction:

:SLOT:TYPE	:LINK	Length (bits)	*RST value.
TCH	UP	2	2
SYNC	UP	48	9999 9999 9999
VOX	UP	6	26
TCH	DOWN	2	2
SYNC	DOWN	102	26 6666 6666 6666 6666 6666 6666

Example: `:SOUR:PDC:SLOT2:PRE #H1` For *RST value see above

[:SOURce]:PDC:SLOT<i>:SYNC #H0 to #HFFFFF/FFFFFFFF (20/32 bits)

The command sets the value of the sync word. The length 32bit is only available for `SLOT:TYPE SYNC`.

Example: `:SOUR:PDC:SLOT2:SYNC #H1A` *RST value depends on SLOT

[:SOURce]:PDC:SLOT<i>:SYNC2 #H0 to #HFF... (20/32 bits)

The command sets the value for the sync word in the superframe (only available for `:PDC:SFRA:STAT ON`).

Example: `:SOUR:PDC:SLOT2:SYNC2 #H1AB` *RST value is 0

[:SOURce]:PDC:SLOT<i>:CCODe #H0 to #HFF (8 bits)

The command sets the value for the color code.

Example: `:SOUR:PDC:SLOT2:CCOD #H1F` *RST value is 0

[:SOURce]:PDC:SLOT<i>:POSTamble #H0 to 3FF... (78 bits)

The command sets the value for postamble (only valid for `SLOT:TYP SYNC` and `LINK DOWN`).

Example: `:SOUR:PDC:SLOT2:POST #HF2` *RST value is 2666 6666 6666 6666 6666

[:SOURce]:PDC:SLOT<i>:SF 0 | 1

The command sets the state of the steal flag.

Example: `:SOUR:PDC:SLOT2:SF 1` *RST value is 0

3.5.11.16 SOURce:PHASe Subsystem

Command	Parameter	Default Unit	Remark
[:SOURce]			
:PHASe			
[:ADJust]	-360 deg to +360 deg	rad	
:REFerence			No query

[:SOURce]:PHASe[:ADJust] -360 deg to +360 deg

The command indicates the phase between output signal and reference oscillator signal. This setting is only accepted using `SOURce:PHASe:REFerence` (cf. below). An indication in RADian is possible.

Example: `:SOUR:PHAS:ADJ 2DEG`

`:SOUR:PHAS:ADJ 0.1RAD` *RST value is 0.0 DEG

[:SOURce]:PHASe:REFerence

The command accepts the phase set using `SOURce:PHASe:ADJust` as a new reference phase. The command has no *RST value.

Example: `:SOUR:PHAS:REF`

3.5.11.17 SOURce:PHS Subsystem (Digital Standard)

Note *#H0 to #HF are characters which are entered in alphanumeric Hex form manually. SCPI (and IEEE 488.2) also accept the entry of non-decimal characters in octal and binary such as*
#Hlh <0 to 9, Ala to Flf>,
#Qlq <0 to 7> and
#Blb <0l1>.
The characters are always output in Hex format after a query.

Command	Parameter	Default unit	Remark
[:SOURce]			
:PHS			
:STATe	ON I OFF		
:STANdard			No query
:SRATe	1kHz to 200 kHz	Hz	
:FILTer			
:TYPE	SCOSine I COSine		
:PARameter	0.1 to 0.7		
:MODE	LACP I LEVM		
:LDIStortion			
[:STATe]	ON I OFF		
:SEQuence	AUTO I RETRigger I AAUTo I ARETrigger		
:TRIGger			
:SOURce	EXTernal I INTernal		
:INHibit	0 to 67.1E6		
:DELay	0 to 65535		
:OUTPut[2]			
:DELay	0 to 959		
:PERiod	1 to 67.1E6		
:CLOCk			
:SOURce	INTernal I EXTernal		
:MODE	BIT I SYMBol I SBIT		
:DELay	0 to 1.0		
:PRAMp			
:PRESet			No query
:TIME	0.25 to 16		
:DELay	1.0 to +1.0		
:SHAPe	LINear I COSine		
:ROFFset	-9 to +9		
:FOFFset	-9 to +9		
:SLOT			
:ATTenuation	0 to 70 dB	dB	

Command	Parameter	Default unit	Remark
[:SOURce]			
:PHS			
:FLISt			
:PREDefined			
:CATalog?	⇒ name {,name}...		query only
:LOAD	'name'		
:CATalog?	⇒ name {,name}...		query only
:LOAD	'name'		
:STORe	'name'		no query
:DELete	'name'		no query
:DLISt			
:CATalog?			query only
:SLOT<i>			
:TYPE	TCHFull | TCHHalf | SYNC | VOX | ADATa		
:LEVel	OFF | ATT | FULL		
:PRESet	-		No query
:SCRamble			
:STATe	ON | OFF		
:CODE	#H0 to #H3FF (10 bit)		
:ENCRyption			
:STATe	ON | OFF		
:KEY	#H0 to #HFFFF (16 bits)		
:UWORd	#H0 to #HFFFFFFFF (16 o r 32 bits)		
:CSID	#H0 to #H3FFFFFFFFFF (42 bits)		
:PSID	#H0 to #HFFFFFFF (28 bits)		
:IDLe	#H0 to #H3FFFFFFFF (34 bits)		
[:SOURce]			
:SACChannel	PN9 | PN11 | PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		
:TCHannel	PN9 | PN11 | PN15 | PN 16 | PN20 | PN21 | PN23 | DLISt | SDATa		
:DLISt	'name'		

[:SOURce]:PHS:STATe ON | OFF

The command switches the modulation on according to PHS standard. All other standards that might be switched on or digital modulation are automatically switched OFF.

Example: `:SOUR:PHS:STAT ON` *RST value is OFF

[:SOURce]:PHS:STANdard

The commands sets all modulation parameters to the values of the PHS standard. I.e., all values that have been selected by the `:PHS:SLOT...` commands described in the following are not valid. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PHS:STAN`

[:SOURce]:PHS:SRATe 1kHz to 200 kHz

The command sets the symbol rate.

Example: `:SOUR:PHS:SRAT 192.1 kHz` *RST value is 192 kHz

[:SOURce]:PHS:FILTer

The commands for selecting a filter are under this node.

[:SOURce]:PHS:FILTer:TYPE SCOSinelCOSine

The command selects the type of filter.

Example: `:SOUR:PHS:FILT:TYPE COS` *RST value is SCOS

[:SOURce]:PHS:FILTer:PARameter 0.1 to 0.7

The command sets the filter parameter entry (Roll Off factor).

Example: `:SOUR:PHS:FILT:PAR 0.5` *RST value is 0. 5

[:SOURce]:PHS:FILTer:MODE LACP I LEVM

This command selects one of the "L"ow filter modes.

Example: `:SOUR:PHS:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:PHS:LDIStortion[:STATe] ON I OFF

The command sets the reduced level for the low-distortion mode.

Example: `:SOUR:PHS:LDIS ON` *RST value is OFF

[:SOURce]:PHS:SEQuence AUTO I RETRigger I AAUTo I ARETrigger

The command selects the trigger mode for the sequence.

AAUTo is ARMED AUTO
ARETrigger is ARMED RETRIG

Example: `:SOUR:PHS:SEQ AAUT` *RST value is AUTO

[:SOURce]:PHS:TRIGger:SOURce EXTernal I INTernal

The command selects the trigger source. With INT selected, triggering is via IEC/IEEE bus or the Execute command in manual control.

Example: `:SOUR:PHS:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:PHS:TRIGger:INHibit 0 to 67.1E6

The command sets the retrigger inhibit duration (in number of symbols).

Example: `:SOUR:PHS:TRIG:INH 1000` *RST value is 0

[:SOURce]:PHS:TRIGger:DELay 0 to 65535

The command sets the trigger delay (in number of symbols).

Example: `:SOUR:PHS:TRIG:DEL 200` *RST value is 0

[:SOURce]:PHS:TRIGgerOUTPut[2]:DELay 0 to 959

The command determines the delay of the signal at trigger output 2 in comparison with the start of the frames in number of symbols.

Example: `:SOUR:PHS:TRIG:OUTP2:DEL 16` *RST value is 0

[:SOURce]:PHS:TRIGger:OUTPut[2]:PERiod 1 to 67.1E6

The command sets the repeat rate (in number of frames) of the signal at trigger output 2.

Example: `:SOUR:PHS:TRIG:OUTP:PER 8` *RST value is 1

[:SOURce]:PHS:CLOCk

The commands for setting the data clock are under this node.

[:SOURce]:PHS:CLOCk:SOURce INTernal | EXTernal

The command selects the source for the DM data clock.

INTernal	The internal clock generator is used and output via the clock outputs of the serial and parallel interface.
EXTernal	The clock is externally fed in via the serial interface and output via the parallel interface.

Example: `:SOUR:PHS:CLOC:SOUR INT` *RST value is INT

[:SOURce]:PHS:CLOCk:MODE BIT | SYMBol

The command sets the clock mode for `:PHS:CLOCk:SOURce EXTernal`.

BIT	The external clock has to be a bit clock.
SYMBol	The external clock has to be a symbol clock.

The bit and symbol clock only differ for modulations with more than two states, ie modulations for which more than one bit is required to code each state.

Example: `:SOUR:PHS:CLOC:MODE BIT` *RST value is SYMB

[:SOURce]:PHS:CLOCk:DELay 0 to 1.0

The command sets the delay of the symbol clock (as a fraction of the length of a symbol).

Example: `:SOUR:PHS:CLOC:DEL 0.75` *RST value is 0

[:SOURce]:PHS:PRAMp

The commands for the level control of the burst are under this node.

[:SOURce]:PHS:PRAMp:PRESet

This command sets the standard-stipulated values for the following commands of level control. It is an event and hence has no query and no *RST value.

Example: `:SOUR:PHS:PRAM:PRES`

[:SOURce]:PHS:PRAMp:TIME 0.25 to 16.0

The command sets the cutoff steepness (in symbol clocks).

Example: `:SOUR:PHS:PRAM:TIME 2.5` *RST value is 0

[:SOURce]:PHS:PRAMp:DELay -1.0 to + 1.0

The command defines the shift of the envelope characteristic to the modulated signal. A positive value causes a delay of the envelope.

Example: `:SOUR:PHS:PRAM:DEL 0.2` *RST value is 0

[:SOURce]:PHS:PRAMp:SHAPe LINear | COSine

The command selects the linear or cosine shape of the ramp-up and ramp-down (power burst).

Example: `:SOUR:PHS:PRAM:SHAP COS` *RST value is LIN

[:SOURce]:PHS:PRAMp:ROFFset -9 to +9

The command determines the timing of the ('R'ising) edge of a power burst to the beginning of the slot.

Example: `:SOUR:PHS:PRAM:ROFF -3` *RST value is 0

[:SOURce]:PHS:PRAMp:FOFFset -9 to +9

The command determines the timing of the ('F'alling) edge of a power burst to the data block

Example: `:SOUR:PHS:PRAM:FOFF 4` *RST value is 0

[:SOURce]:PHS:SLOT:ATTenuation 0 to 70 dB

The command determines the amount by which the power of the slots marked by `:PHS:SLOT:LEVEL ATT` is reduced in comparison with the normal output power (Attribut to `:LEVEL FULL`).

Example: `:SOUR:PHS:SLOT:ATT 20 dB` *RST value is 0

[:SOURce]:PHS:FLISt

The commands for storing and reading complete frames including their bursts (slots) are under this node. Predefined and user-generated frames have to be distinguished.

[:SOURce]:PHS:FLISt:PREDefined:CATalog?

The command returns a list of all predefined frames.

Example: `:SOUR:PHS:FLIS:PRED:CAT?`

[:SOURce]:PHS:FLISt:PREDefined:LOAD 'name'

The command selects one of the predefined (fixed) frames (c.f. Chapter 2). This command triggers an event and hence has no *RST value.

Example: `:SOUR:PHS:FLIS:PRED:LOAD 'test'` *RST value is 0

[:SOURce]:PHS:FLISt:CATalog?

The command returns a list of all user-defined frames.

Example: `:SOUR:PHS:FLIS:CAT?`

[:SOURce]:PHS:FLISt:LOAD 'name'

The command loads a user-defined frame. This command triggers an event and hence has no *RST value.

Example: `:SOUR:PHS:FLIS:LOAD 'test'`

[:SOURce]:PHS:FLISt:STORe 'name'

The command stores the current frame under a name. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PHS:FLIS:STOR 'test'`

[:SOURce]:PHS:FLISt:DELete 'name'

The command deletes the indicated frame. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PHS:FLIS:DEL 'test1'`

[:SOURce]:PHS:DLISt:CATalog?

The command returns an enumeration of all data lists.

These data lists are selected by means of `:PHS:SLOT:SACC:DLIS 'name'` and `...:TCH:DLIS 'name'` and used if `:PHS:SLOT:SACC DLISt` and `...:TCH DLISt` are set.

Example: `:SOUR:PHS:DLIS:CAT?`

[:SOURce]:PHS:SLOT<i>

The commands for setting the slot characteristics are under this node. Since a frame contains 8 slots, suffix 'i' is used to select the slot to be changed. i = [1] | 2 | 3 | 3 | 5 | 6 | 7 | 8

[:SOURce]:PHS:SLOT<i>:TYPE TCHFull | TCHHalf | SYNC | VOX | ADATa

The command selects the type of burst (slot) defined in the standard.

ADATa All Data

Example: `:SOUR:PHS:SLOT2:TYPE TCHH` Slot1: *RST value is SYNC
Slot2 to 8: *RST value is TCHF

[:SOURce]:PHS:SLOT<i>:LEVel OFF | ATT | FULL

The command determines the power stage of the slot.

OFF	The slot is inactive For UPLINK, the source is always at full power. Therefore, in the case of an DOWNLINK TCH burst, only a series of 1's is sent instead of the data.
ATT	The power is reduced by the amount defined by `:PHS:SLOT:ATT` For an DOWNLINK TCH burst this setting is not valid.
FULL	Full power (predefined by level setting)

Example: `:SOUR:PHS:SLOT2:LEV ATT` slot1: *RST value is FULL
slot2 to slot8: *RST value is OFF

[:SOURce]:PHS:SLOT<i>:PRESet

The command sets all the parameters of the slot to the values defined by the standard as a function of the type set above. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:PHS:SLOT2:PRES`

[:SOURce]:PHS:SLOT<i>:SCRamble

The commands for setting the scramble method are under this node.

[:SOURce]:PHS:SLOT<i>:SCRamble:STATe ON | OFF

The command switches scrambling on or off.

Example: `:SOUR:PHS:SLOT2:SCR:STAT ON` *RST value is OFF

[:SOURce]:PHS:SLOT<i>:SCRamble:CODE #H0 to #H3FF

The command sets the 10-bit scramble value.

Example: `:SOUR:PHS:SLOT2:SCR:CODE #H123` *RST value is 0

[:SOURce]:PHS:SLOT<i>:ENCRyption

The commands to determine encryption are unde this node.

[:SOURce]:PHS:SLOT<i>:ENCRyption:STATe ON | OFF

This command defines whether or not the data are to be encrypted according to the predefined method.

Example: `:SOUR:PHS:SLOT2:ENCR:STAT ON` *RST value is OFF

[:SOURce]:PHS:SLOT<i>:ENCRyption:KEY #H0 to #HFFFF

The command enters the 16-bit code for encryption or decryption .

Example: `:SOUR:PHS:SLOT2:KEY #H1234` *RST value is 0

[:SOURce]:PHS:SLOT<i>:UWORd #H0 to #HFFFFFFFF

The command enters the 16/32-bit synchronization value (unique word). The number of bits depends on the type of slot. *RST value depends on `SLOT:TYPE`

Example: `:SOUR:PHS:SLOT2:UWOR #HA1B2C3D4`

[:SOURce]:PHS:SLOT<i>:CSID #H0 to #H3FFFFFFFFFF

The command enters the 42-bit cell station ID code .

Example: `:SOUR:PHS:SLOT2:CSID #H12345FEDCBA`

[:SOURce]:PHS:SLOT<i>:PSID #H0 to #HFFFFFFF

The command enters the 28-bit personal station ID code.

Example: `:SOUR:PHS:SLOT2:PSID #H1234567`

[:SOURce]:PHS:SLOT<i>:IDLe #H0 to #HFFFFFFF

The command enters the 24-bit Idle bit.

Example: `:SOUR:PHS:SLOT2:PSID #H1234567`

[:SOURce]:PHS:SLOT<i>[:SOURce]

The commands for determining the source for the data contents are under this node. The source is either a PRBS generator (with different sequence length) or a data list.

Selection of data source for the data fields of the burst:

PN9 to 23	PRBS generator has been selected
DLISt	Data of a programmable data list
SDATa	Data from data input SER DATA

[:SOURce]:PHS:SLOT<i>[:SOURce]:SACChannel PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the slow associated control channel (for `:SLOT:TYPE TCH...` and `VOX`).

Example: `:SOUR:PHS:SLOT3:SACC PN15` *RST value is PN9

[:SOURce]:PHS:SLOT<i>[:SOURce]:SACChannel:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:PHS:SLOT:SACC DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:PHS:SLOT:SACC:DLIS 'test'`

[:SOURce]:PHS:SLOT<i>[:SOURce]:TCHannel PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa

The command determines the data source for the traffic channel (for `:SLOT:TYPE TCH...` and `VOX`).

Example: `:SOUR:PHS:SLOT2:TCH PN9` *RST value is PN9

[:SOURce]:PHS:SLOT<i>[:SOURce]:TCHannel:DLISt 'name'

The command selects a data list. This list will not be used unless it is set as a data source by means of the `:PHS:SLOT:TCH DLIS` command. This command triggers an event and hence has no *RST value.

Example: `:PHS:SLOT:TCH:DLIS 'test'`

3.5.11.18 SOURce:PM Subsystem

This subsystem contains the commands to check the phase modulation and to set the parameters of the modulation signal. The SMIQ can be equipped with two independent phase modulators (option SM-B5). They are differentiated by a suffix after PM.

SOURce:PM1
SOURce:PM2

Command	Parameter	Default Unit	Remark
[:SOURce]			
:PM1|2			Option SM-B5
[:DEViation]	-360 deg to +360 deg	rad	
:EXTernal1|2			
:COUPling	AC | DC		
:INTernal			
:FREQuency	0.1Hz to 1 MHz	Hz	
:SOURce	INT | EXT1 | EXT2		
:STATe	ON | OFF		

[:SOURce]:PM1|2[:DEViation] -360 to +360 deg

The command sets the modulation depth in Radian. DEGree are accepted.

*RST value is 1 rad

Example: `SOUR:PM:DEV 20DEGR`

[:SOURce]:PM1|2:EXTernal1|2

The commands to check the external input of the PM modulators are under this node. The settings under EXTernal for modulations AM, FM and PM are independent of each other. The settings are always related to the socket determined by the suffix after EXTernal. The suffix after PM is ignored then. With the following commands, e.g., the settings are both related to socket EXT2:

```
:SOUR:PM1:EXT2:COUP AC
:SOUR:PM2:EXT2:COUP AC
```

A command without suffix is interpreted like a command with suffix 1.

[:SOURce]:PM1|2:EXTernal1|2:COUPling AC | DC

The command selects the type of coupling for the external PM input.

AC The d.c. voltage content is separated from the modulation signal.

DC The modulation signal is not changed.

*RST value is AC

Example: `:SOUR:PM:COUP DC`

[:SOURce]:PM1|2:INTernal

The settings for the internal PM generators are effected under this node. For PM1, this is always LF generator 1, for PM2, always LF generator 2. Here the same hardware is set for FM1, PM1, AM::INT1 as well as SOURce0, for FM2, PM2 and AM:INT2 and SOURce2 as well. This means that, e.g., the following commands are coupled with each other and have the same effect:

```
SOUR:AM:INT2:FREQ
SOUR:FM2:INT:FREQ
SOUR:PM2:INT:FREQ
SOUR2:FREQ:CW
```

[:SOURce]:PM1|2:INTernal:FREQuency 0.1 Hz to 1 MHz

The command sets the modulation frequency. *RST value is 1 kHz

Example: `:SOUR:PM:INT:FREQ 10kHz`

[:SOURce]:PM1|2:SOURce INTernal | EXTernal1 | EXTernal2

The command selects the modulation source. A command without suffix is interpreted like a command with suffix 1. For PM1 the LF generator is INTernal. For PM2, only the external sources can be used (not the internal LF generator).

The external and the internal modulation source can be indicated at the same time (see example)

*RST value for PM1: INT

Example: `:SOUR:PM:SOUR INT; PM2:SOUR EXT2` for PM2: EXT2

[:SOURce]:PM1|2:STATe ON | OFF

The command switches the phase modulation selected by the numeric suffix with PM on or off.

Example: `:SOUR:PM1:STAT OFF` *RST value is OFF

3.5.11.19 SOURce:POWer Subsystem

This subsystem contains the commands to set the output level, the level control and the level correction of the RF signal. Other units can be used instead of dBm:

- by indication directly after the numeric value (Example `:POW 0.5V`),
- by altering the DEFault unit in the UNIT system (see Command `:UNIT:POWER`)

Command	Parameter	Default Unit	Remark
[:SOURce]			
:POWer			
:ALC			
[:STATe]	ON | OFF | AUTO		
:SEARch	ON | OFF | ONCE		
:TABLe			
[:MEASure]?			query only
[:LEVel]			
[:IMMediate]			
[:AMPLitude]	-144 to +16 dBm	dBm	
:OFFSet	-100 to +100 dB	dB	
:RCL	INCLude | EXCLude		
:LIMit			
[:AMPLitude]	-144 to +16 dBm	dBm	
:MANual	-144 to +16 dBm	dBm	
:MODE	FIXed | SWEep | LIST		
:PEP?			
:STARt	-144 to +16 dBm	dBm	
:STOP	-144 to +16 dBm	dBm	
:STEP			
[:INCRement]	0.1 to 10 dB	dB	

[:SOURce]:POWer:ALC

The commands checking the automatic level control are under this node.

[:SOURce]:POWer:ALC:TABLe[:MEASure]?

The command starts a calibration measurement. It fills the level table for the `POW:ALC:SEARCH OFF` mode.

Example: `:SOUR:POW:ALC:TABL:MEAS?` Answer: 0

[:SOURce]:POWer:ALC[:STATe] ON | OFF | AUTO

The command switches level control on or off.

ON	Level control is permanently switched on.
OFF	Level control is handled depending on `POW:ALC:SEAR` described below.
AUTO	Depending on the operating mode, level control is automatically switched on or off.

Example: `:SOUR:POW :ALC:STAT ON` *RST value is ON

[:SOURce]:POWer:ALC:SEARch ON I OFF I ONCE

This command is only valid with level control switched off.

ON	Level control is switched on briefly after a level or frequency change (SAMPLE & HOLD).
OFF	Level control is never switched on (TABLE mode).
ONCE	Level control is briefly switched on for calibration.

Example: `:SOUR:POW :ALC:SEAR ONCE` *RST value: OFF

[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude] -144 to +16 dBm

The command sets the RF output level in operating mode CW. UP and DOWN can be indicated in addition to numeric values. Then the level is increased or reduced by the value indicated under `:SOURce:POWer:STEP`.

In this command, the OFFSet value is considered as with input value AMPLITUDE in the LEVEL-LEVEL menu. Thus the specified range indicated is only valid for `:POWer:OFFSet = 0`. The specified range with other OFFSet values can be calculated according to the following formula (cf. Chapter 2, Section "Level Offset" as well):

-144dBm+ OFFSet to +16dBm +OFFSet

The keywords of this command are optional to a large extent, thus the long as well as the short form of the command is shown in the example. *RST value is -30 dBm

Example: `:SOUR:POW:LEV:IMM:AMPL 15` or
`:POW 15`

[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet -100 to +100 dB

The command enters the constant level offset of a series-connected attenuator/ amplifier (cf. Chapter 2, Section "Level Offset"). If a level offset is entered, the level entered using :POWer:AMPLitude does no longer conform to the RF output level. The following connection is true:

`:POWer` = RF output level + `POWer:OFFSet`.

Entering a level offset does not change the RF output level but only the query value of `:POWer:AMPLitude`.

Only dB is permissible as a unit here, linear units (V, W etc.) are not permitted.

***Caution**: The level offset is also valid in the case of level sweeps!*

Example: `:SOUR:POW:LEV:IMM:OFFS 0` or *RST value is 0
`:POW:OFFS 0`

[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]:RCL INCLude I EXCLude

The command determines the effect of the recall function on the RF level.*RST value has no effect to this setting.

INCLude	The saved RF level is loaded when instrument settings are loaded with the [RECALL] key or with a memory sequence.
EXCLude	The RF level is not loaded when instrument settings are loaded, the current settings are maintained.

Example: `:SOUR:POW:RCL INCL`

[:SOURce]:POWer:LIMit[:AMPLitude] -144 to + 16 dBm

The command limits the maximum Rf output level in operating mode CW and SWEEP. It does not influence the display LEVEL and the answer to query `POW?`.

Example: `:SOUR:POW:LIM:AMPL 15` *RST value is +16 dBm

[:SOURce]:POWer:MANual -144 to +16 dBm

The command sets the level if `SOURce:POWer:MODE` is set to SWEep and `SOURce:SWEep:MODE` to MANual. Only level values between START and STOP are permissible. (As to specified range, cf. `:POWer`). *RST value is -30 dBm

Example: `:SOUR:POW:MAN 1dBm`

[:SOURce]:POWer:MODE FIXed | SWEep | LIST

The command specifies the operating mode and thus also by means of which commands the level setting is checked.

FIXed	The output level is specified by means of commands under `:SOURce:POWer:LEVel.`
SWEep	The instrument operates in the SWEep mode. The level is specified by means of `:SOURce:POWer;STARt; STOP; CENTer; SPAN` and `MANual`.
LIST	The instrument processes a list of frequency and level settings. The settings are effected in the `SOURce:LIST` subsystem. Setting `:SOURce:POWer:MODE LIST` automatically sets command `:SOURce :FREQuency :MODE to LIST` as well.

Example: `:SOUR:POW:MODE FIX` *RST value is FIXed

[:SOURce]:POWer:PEP?

This command returns the peak envelope power in dBm (Digital Modulation and Digital Standards)

Example: `:POW:PEP?`

[:SOURce]:POWer:STARt -144 to +16 dBm

The command sets the starting value for a level sweep. STARt may be larger than STOP, then the sweep runs from the high to the low level (As to specified range, cf. `:POWer:AMPLitude)`.

Example: `:SOUR:POW:STAR -20` *RST value is -30dBm

[:SOURce]:POWer:STOP -144 to +16 dBm

The command sets the final value for a level sweep. STOP may be smaller than STARt. (As to specified range, cf. `:POWer:AMPLitude`). *RST value is -10dBm

Example: `:SOUR:POW:STOP 3`

[:SOURce]:POWer:STEP[:INCRement] 0.1 to 10 dB

The command sets the step width with the level setting if UP and DOWN are used as level values. The command is coupled with KNOB STEP in the manual control, i.e., it also specifies the step width of the shaft encoder.

Only dB is permissible as a unit here, the linear units (V, W etc.) are not permitted.

Example: `:SOUR:POW:STEP:INCR 2` *RST value is 1dB

3.5.11.20 SOURce:PULM Subsystem

This subsystem contains the commands to check the external pulse modulation

Command	Parameter	Default Unit	Remark
[:SOURce]			
:PULM			
:POLarity	NORMal I INVerted		
:STATe	ON I OFF		

[:SOURce]:PULM:POLarity NORMal I INVerted

The command specifies the polarity between modulating and modulated signal.

NORMal	The RF signal is suppressed during the interpulse period.
INVerted	The RF signal is suppressed during the pulse.

Example: `:SOUR:PULM:POL INV` *RST value is NORMal

[:SOURce]:PULM:STATe ON I OFF

The command switches on or off the pulse modulation. *RST value is OFF

Example: `:SOUR:PULM:STAT ON`

3.5.11.21 SOURce:ROSCillator Subsystem

This subsystem contains the commands to set the external and internal reference oscillator.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:ROSCillator			
:EXTernal			
:FREQuency	1 to 16 MHz	Hz	
[:INTernal]			
:ADJust			
[:STATe]	ON I OFF		
:VALue	0 to 4095		
:SOURce	INTernal I EXTernal		

[:SOURce]:ROSCillator:EXTernal

The commands to set the external reference oscillator are under this node.

[:SOURce]:ROSCillator:EXTernal:FREQuency 1 to 16 MHz

The command informs the instrument about at which frequency the external reference oscillator oscillates.

Example: `:SOUR:ROSC:FREQ 5MHz` *RST value is 10 MHz

[:SOURce]:ROSCillator[:INTernal]

The commands to set the internal reference oscillator are under this node.

[:SOURce]:ROSCillator[:INTernal]:ADJust

The commands for frequency correction (fine adjustment of the frequency) are under this node.

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] ON I OFF

The command switches the fine adjustment of the frequency on or off.

Example: `:SOUR:ROSC:INT:ADJ:STAT ON` *RST value is OFF

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue 0 to 4095

The command indicates the frequency correction value (tuning value). For a detailed definition, cf. Chapter 2, Section "Reference Frequency Internal/External".

Example: `:SOUR:ROSC:INT:ADJ:VAL 2048` *RST value is 2048

[:SOURce]:ROSCillator:SOURce INTernal I EXTernal

The command selects the reference source.

INTernal	The internal oscillator is used.
EXTernal	The reference signal is fed externally.

*RST value is INT

Example: `:SOUR:ROSC:SOUR EXT`

3.5.11.22 SOURce:SWEep Subsystem

This subsystem contains the commands to check the RF sweep, i.e., sweeps of the RF generators. Sweeps are triggered on principle. The frequency sweep is activated by command `SOURce: FREQuency:MODE SWEep`, the level sweep by command `SOURce:POWer:MODE SWEep`.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:SWEep			
:BTIMe	NORMal I LONG		
[:FREQuency]			
:DWELl	10 ms to 5 s	s	
:MODE	AUTO I MANual I STEP		
:POINts	Number		
:SPACing	LINear I LOGarithmic		
:STEP			
[:LINear]	0 to 1 GHz	Hz	
:LOGarithmic	0.01 to 50 PCT	PCT	
:POWer			
:DWELl	10 ms to 5 s	s	
:MODE	AUTO I MANual I STEP		
:POINts	Number		
:STEP			
[:LOGarithmic]	0 to 10 dB	dB	

[:SOURce]:SWEep:BTIMe NORMal I LONG

The command sets the blank time (Blank TIMe) of the sweep. The setting is valid for all sweeps, i.e., also for LF sweeps.

NORMal Blank time as short as possible.

LONG Blank time long enough to permit an XY recorder to return to 0.

Example: `:SOUR:SWE:BTIM LONG` *RST value is NORM

[:SOURce]:SWEep[:FREQuency]

The commands to set the frequency sweeps are under this node. Keyword `[:FREQuency]` can be omitted (cf. examples). The commands are SCPI compatible then unless stated otherwise.

[:SOURce]:SWEep[:FREQuency]:DWELl 10 ms to 5 s

The command sets the dwell time per frequency step.

Example: `:SOUR:SWE:DWEL 12ms` *RST value is 15 ms

[:SOURce]:SWEep[:FREQuency]:MODE AUTO I MANual I STEP

The command specifies the run of the sweep.

AUTO	Each trigger triggers exactly one entire sweep cycle.
MANual	Each frequency step of the sweep is triggered by means of manual control or a `SOURce:FREQuency:MANual` command, the trigger system is not active. The frequency increases or decreases (depending on the direction of the shaft encoder) by the value indicated under `[:SOURce]:FREQuency:STEP:INCRement.`
STEP	Each trigger triggers only one sweep step (single-step mode). The frequency increases by the value indicated under `[:SOURce]:SWEep:STEP:LOGarithmic.`

Example: `:SOUR:SWE:MODE AUTO` *RST value is AUTO

[:SOURce]:SWEep[:FREQuency]:POINts Number

The command determines the number of steps in a sweep.

Instead of this command, commands `SOURce:SWEep:FREQuency:STEP:LINear` and `SOURce:SWEep:FREQuency:STEP:LOGarithmic` should be used, as `SOURce:SWEep :FREQuency:POINts` has been adapted to the instrument characteristics in comparison to the SCPI command.

The value of POINts depends on SPAN and STEP according to the following formulas..

The following is true for linear sweeps : POINts = SPAN / STEP:LIN + 1

The following is true for logarithmic sweeps and STARt < STOP:

POINts = ((log STOP - log STARt) / log (1+ STEP:LOG))

Two independent POINts values are used for SPACing LOG and SPACing LIN. I.e., before POINts is changed, SPACing must be set correctly. A change of POINts results in an adaptation of STEP, but not of STARt, STOP and SPAN.

Example: `:SOUR:SWE:POIN 100`

[:SOURce]:SWEep[:FREQuency]:SPACing LINear I LOGarithmic

The command selects whether the steps have linear or logarithmic spacings.

Example: `:SOUR:SWE:SPAC LIN` *RST value is LINear

[:SOURce]:SWEep[:FREQuency]:STEP[:LINear] 0 to 1 GHz

The command sets the step width with the linear sweep. If STEP[:LINear] is changed, the value of POINts valid for SPACing:LINear also changes according to the formula stated under POINts. A change of SPAN does not result in a change of STEP[:LINear]. Keyword [:LINear] can be omitted, then the command conforms to SCPI regulations (see example).

Example: `:SOUR:SWE:STEP 1MHz` *RST value is 1 MHz

[:SOURce]:SWEep[:FREQuency]:STEP:LOGarithmic 0.01 to 50 PCT

The command indicates the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated according to

new frequency = prior frequency + STEP:LOG x prior frequency (if STARt < STOP)

STEP:LOG indicates the fraction of the prior frequency by which this is increased for the next sweep step. Usually STEP:LOG is indicated in percent, with the suffix PCT having to be used explicitly. If STEP:LOG is changed, the value of POINts valid for SPAC:LOG also changes according to the formula stated under POINts. A change of STARt or STOP does not result in a change of STEP:LOG.

Example: `:SOUR:SWE:STEP:LOG 10PCT` *RST value is 1 PCT

[:SOURce]:SWEep:POWer:DWELl 10 ms to 5 s

The command sets the dwell time per level step.

Example: `:SOUR:SWE:POW:DWEL 12ms` *RST value is 15 ms

[:SOURce]:SWEep:POWer:MODE AUTO I MANual I STEP

The command specifies the run of the sweep.

AUTOEach trigger triggers exactly one entire sweep cycle.

MANual Each level step of the sweep is triggered by means of manual control or a `SOURce:POWer:MANual` command, the trigger system is not active. The level increases or decreases (depending on the direction of the shaft encoder) by the value stated under `:SOURce:POWer:STEP:INCRement`.

STEP Each trigger triggers only one sweep step (single-step mode). The level increases by the value indicated under `:SOURce:POWer:STEP:INCRement`.

Example: `:SOUR:SWE:POW:MODE AUTO` *RST value is AUTO

[:SOURce]:SWEep:POWer:POINts Number

The command determines the number of steps in a sweep. Instead of this command, command `SOURce:SWEep:POWer:STEP:LOGarithmic` should be used, as POINts has been adapted to the instrument characteristics in comparison to the SCPI command.

The value of :POINts depends on .SPAN and :STEP according to the following formulas:

POINts = ((log STOP - log STARt) / log STEP:LOG) + 1

A change of POINts results in an adaptation of STEP but not of STARt and STOP.

Example: `:SOUR:SWE:POW:POIN 100`

[:SOURce]:SWEep:POWer:STEP

The commands to set the step width for a sweep.

[:SOURce]:SWEep:POWer:STEP[:LOGarithmic] 0 to 10 dB

The command indicates the step width factor for logarithmic sweeps. The next level value of a sweep is calculated according to

new level = prior level + STEP:LOG × prior level

STEP:LOG indicates the fraction of the prior level by which this is increased for the next sweep step. Usually STEP:LOG is indicated in dB, with suffix dB having to be used explicitly. If STEP:LOG is changed, the value of POINts also changes according to the formula indicated under POINts. A change of STARt or STOP does not result in a change of STEP:LOG. Keyword :LOG can be omitted, then the command conforms to SCPI regulation (see example).

Example: `:SOUR:SWE:STEP:LOG 10dB` *RST value is 1dB

3.5.11.23 SOURce:WCDMa Subsystem

Note: *#H0 to #HF are numerals which are entered in alphanumerical hex syntax in manual operation. SCPI (and IEEE 488.2) allow the octal and binary entry for non-decimal numbers in the following form*
#Hlh <0 to 9, Ala to Flf>,
#Qlq <0 to 7> and
#Blb <0l1>.
However, the hex format is always used for the output generated by a query.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:WCDMa			
:STATe	ON I OFF		
:MODE	CHAN4 I CHAN8 I CHAN15		
:PRESet	(without)		
:CRATe	R4M I R8M		
:LINK	DOWN I UP I UPMulti		
:FORMat	QPSK I OQPSK		
:CRATe			
:VARiation	100cps to 7.5Mcps		
:FILTer			
:TYPe	SCOSine I COSine I WCDMa		
:PARameter	0.1... 0.7		
:MODE	LACP I LEVM		
:LDIStortion			
[:STATe]	ON I OFF		
:SEQuence	AUTO I RETRigger I AAUTo I ARETrigger		
:TRIGger			
:SOURce	EXTernal I INTernal		
:INHibit	0 to 67108863		
:DELay	0 to 65535		
:OUTPut[1]I 2	SLOT I RFRame I CSPeriod		
:DELay	0 to 40959 (81919)		
:POLarity	POSitive I NEGative		
:CLOCk			
:SOURce	INTernal I EXTernal		
:POWer?		dBm	query only
:ADJust	(without)		

Command	Parameter	Default Unit	Remark
[:SOURce]			
:WCDMa			
:MULTicode			
:STATe	ON | OFF		
:MASTer	0 to 3		
:CHANnels	#H0 to #H7FFF		
:SLENgth	1 to 256		
:CHANnel<0..14>			
[:I] | :Q			
:TYPE	PERCh | CCPCh | DPCH | DPDCh | DPCCh | ALLD		
:SRATe	D16 | D32 | D64 | D128 | D256 | D512 | D1024		
:SCODe	0 to 511		
:LCODe	#H0 to #H3FFFF (#H1FFFFFFFFFF)		
:OFFSet	0 to 40959 (81919)		
:SCODe			
:LMS	#H0 to #HFF		
[:I] | :Q			
:POWer	-30 to 0	dB	
:DATA	PN9 | PN11 | PN15 | PN16 | DLISt		
:DLISt	'name'		
:OFFSet	0 to 10239		
:TPC	ZERO | ONE | ALTernate | DLISt		
:DLISt	'name'		
:STATe	ON | OFF		

Note: *The calculation of the W-CDMA sequences is rather time-consuming and should be restarted for any new setting. The WCDMA modulation is therefore switched off for each command (autom. WCDM:STAT OFF performed). The user can then perform several settings without any delay and has to switch on again the WCDMA modulation (with WCDM:STAT ON). The calculations are performed and the previous settings are effective after the command is given.*

[:SOURce]:WCDMa:STATe ON | OFF

The command switches on the modulation in line with the W-CDMA procedure (ARIB standard). Option SMIQB43 is required for this purpose. All other standards that are switched on or the digital modulation are automatically switched to off state.

Caution: The command with ON should be used after any `:WCDM` command or after a series of WCDM commands in order to activate the previous settings.

Example: `:SOUR:WCDM:STAT ON` *RST value is OFF

[:SOURce]:WCDMa:MODE CHAN4 | CHAN8 | CHAN15

The command selects the number of code channels. The limitations for setting the power of different channels thus become effective.

Example: `:SOUR:WCDM:MODE CHAN4` *RST value is CHAN8

[:SOURce]:WCDMa:PRESet

The command sets all the following settings to a defined initial state (as after *RST). This ensures that a signal is actually generated and that it is in line with the standard. This command triggers an event and hence has no *RST value and no query.

Example: `:SOUR:WCDM:PRES`

[:SOURce]:WCDMa:CRATe R4M | R8M

The command sets the chip rate (4.096M or 8.192Mcps). R8M is possible only with a certain hardware configuration.

Example: `:SOUR:WCDM:CRAT R4M` *RST value is R4M

[:SOURce]:WCDMa:LINK DOWN | UP | UPMulti

The command selects the mode of the transmitted signal.

Example: `:SOUR:WCDM:LINK UPM` *RST value is DOWN

[:SOURce]:WCDMa:FORMat QPSK | OQPSK

The command selects the type of modulation (OQPSK: Offset QPSK).

Example: `:SOUR:WCDM:FORM OQPSK` *RST value is QPSK

[:SOURce]:WCDMa:CRATe:VARiation 100cps to 7.5Mcps

The command selects the modification of the chip-clock frequency set with `:WCDM:CRAT R4M | R8M`.

Example: `:SOUR:WCDM:CRAT:VAR 1.2M` *RST value is 4.096M

[:SOURce]:WCDMa:FILTer

The commands for selecting the baseband filter are under this node.

[:SOURce]:WCDMa:FILTer:TYPe SCOSine | COSine | WCDMa

The command selects the type of filter.

SCOSine	Square root cosine (root Nyquist) filter
COSine	Cosinus (Nyquist) filter
WCDMa	Root Nyquist filter with fixed roll-off factor 0.22

Example: `:SOUR:WCDM:FILT:TYP COS` *RST value is WCDM

[:SOURce]:WCDMa:FILTer:PARameter 0.1... 0.7

The command sets the roll-off factor for the COS filters.

Example: `:SOUR:WCDM:FILT:PAR 0.5` *RST value is 0.22

[:SOURce]:WCDMa:FILTer:MODE LACP | LEVM

This command selects one of the "L"ow filter modes.

Example: `:SOUR:WCDM:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:WCDMa:LDIStortion[:STATe] ON | OFF

The command sets the reduced level for the low-distortion mode.

ON	Low-distortion mode
OFF	Normal level

Example: `:SOUR:WCDM:LDIS ON` *RST value is OFF

[:SOURce]:WCDMa:SEQuence AUTO | RETRigger | AAUTo | ARETrigger

The command selects the trigger mode for the W-CDMA sequence.

AUTO	Continuously repeated
RETRigger	Continuously repeated; new start after a trigger
AAUTo	ARMED AUTO; waits for trigger, then switches over to AUTO and can no longer be triggered
ARETrigger	ARMED RETRIG; a trigger event is required to start, each new trigger causes a restart

Example: `:SOUR:WCDM:SEQ AAUT` *RST value is RETR

[:SOURce]:WCDMa:TRIGger:SOURce EXTernal | INTernal

The command selects the trigger source. With INT selected, triggering is via remote control using the trigger command or via EXECUTE TRIGGER in case of manual control.

EXT	The trigger signal is fed in via input TRIGIN
INT	A start is only possible manually or via the remote control command TRIG:DM:IMM

Example: `:SOUR:WCDM:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:WCDMa:TRIGger:INHibit 0 to 67108863

The command sets the retrigger inhibit duration (in number of chips).

Example: `:SOUR:WCDM:TRIG:INH 1000` *RST value is 0

[:SOURce]:WCDMa:TRIGger:DELay 0 to 40959

The command defines the trigger delay (in number of chips).

Example: `:SOUR:WCDM:TRIG:DEL 200` *RST value is 0

[:SOURce]:WCDMa:TRIGger:OUTPut[1]|2 SLOT | RFRame | CSPeriod

The command defines the output signal at trigger output 1 or 2. The following times can be selected:

SLOT	Time slot clock
RFRame	Radio Frame (frame clock)
CSPeriod	Chip Sequence Period

Example: `:SOUR:WCDM:TRIG:OUTP1 RFR` *RST value is: for OUTPut 1: RFR
for OUTPut 2: CSP

[:SOURce]:WCDMa:TRIGger:OUTPut[1]|2:POLarity POSitive | NEGative

The commands defines the polarity of the signals at the trigger outputs.

Example: `:SOUR:WCDM:TRIG:OUTP2:POL NEG` *RST value is POS

[:SOURce]:WCDMa:TRIGger:OUTPut[1]|2:DELay 0 to 40959 (81919)

The command defines the delay of trigger signals in chips.

Example: `:SOUR:WCDM:TRIG:OUTP2:DEL 50` *RST value is 0

[:SOURce]:WCDMa:CLOCk:SOURce INTernal | EXTernal

The command selects the clock source.

INTernal	The internal clock generator is used.
EXTernal	The clock is fed externally via connector SYMBOL CLOCK.

Example: `:SOUR:WCDM:CLOC:SOUR EXT` *RST value is INT

[:SOURce]:WCDMa:POWer?

The command queries the total power for the W-CDMA signal.

Example: `:SOUR:WCDM:POW?`

[:SOURce]:WCDMa:POWer:ADJust

The command modifies the power of each active code channel. This means that the total power is set equal to the power in the level display. The command triggers an action and hence has no *RST value assigned.

Example: `:SOUR:WCDM:POW:ADJ`

[:SOURce]:WCDMa:MULTicode

The commands for selecting multicode settings (not available with `:WCDM:LINK UPMulti`) are under this node.

[:SOURce]:WCDMa:MULTicode:STATe ON | OFF

The command permits to switch on or off the multicode mode.

Example: `:SOUR:WCDM:MULT:STAT OFF`

[:SOURce]:WCDMa:MULTicode:MASTer 0 to 3

The command selects the master channel for the spread code.

Example: `:SOUR:WCDM:MULT:MAST 3`

[:SOURce]:WCDMa:MULTicode:CHANnels #H0 to #H7FFF

The command permits to select the channels for the multicode transmission. Each set bit in the 15-bit hex figure corresponds to a set channel. The figure 9, for example, switches on channel 0 (binary significance) and channel 3 (significance 8).

Example: `:SOUR:WCDM:MULT:CHAN #H3A`

[:SOURce]:WCDMa:SLENgth 1 to 256

The command determines the length of the calculated chip sequence in number of frames.

Example: `:SOUR:WCDM:SLEN 8`

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q

The commands for determining the channel configuration are under this node. For the sense of transmission DOWN (`:WCDM:LINK DOWN`) the settings cannot be separately set to I and Q component; :I and :Q need not be specified.

Example: `:WCDM:CHAN2:TYPE PERC`

For UP, however, there is the multiplex setting (UPMulti) with which settings are distinguished between I and Q. :I is optional, :I is used if no indication is made.

Example: `:WCDM:CHAN2:I:TYPE PERC`

has the same meaning as `:WCDM:CHAN2:TYPE PERC`

Example for Q-component setting: `:WCDM:CHAN2:Q:TYPE PERC`

There are some commands which do not make a distinction between I and Q:

`:WCDM:CHAN<0...14>:LCOD`

`:WCDM:CHAN<0...14>:LCOD OFFS`

`:WCDM:CHAN<0...14>:SCOD:LMS`

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:TYPE PERCh | CCPCh | DPCH | DPDCh | DPCCh | ALLD

The command selects the channel type.

PERCh	Perch Channel (only for `:WCDM:LINK DOWN`)
CCPCh	Common Control Physical Channel (not for `:WCDM:LINK UPM`)
DPCH	Dedicated Physical Channel (not for `:WCDM:LINK UPM`)
ALLD	All Data (not for `:WCDM:LINK UPM`)
DPDCh	Dedicated Physical Data Channel (only for `:WCDM:LINK UPM`)
DPCCh	Dedicated Physical Control Channel (only for `:WCDM:LINK UPM`)

Example: `:SOUR:WCDM:CHAN2:I:TYPE PERC` *RST value is DPCH

*RST value is PERC for channel 0, mode 8, downlink

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:SRATe D16 | D32 | D64 | D128 | D256 | D512 | D1024

The command determines the symbol rate. The values depend on the channel type.

Example: `:SOUR:WCDM:CHAN2:I:SRAT D64` *RST value is D32

*RST value is 16 for channel 0, mode 8, downlink

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:SCODe 0 to 511

The command is used to set the short code of the spread code. The upper limit depends on `:WCDM:CRAT`, `:WCDM:SRAT` and `:WCDM:CHAN:TYPE`.

Example: `:SOUR:WCDM:CHAN2:I:SCOD 123` *RST value is (<chan>+9)

*RST value is 0 for channel 0, mode 8, downlink

:SOURce]:WCDMa:CHANnel<0...14>:LCODe #H0 to #H3FFFF (#H1FFFFFFFFFF)

The command determines the long code of the spread code.

Example: `:SOUR:WCDM:CHAN2:LCOD #H3FFF` *RST value is #H1

[:SOURce]:WCDMa:CHANnel<0...14>:LCODe:OFFSet 0 to 40959 (81919)

The command is used to set the long code offset of the spread code.

Example: `:SOUR:WCDM:CHAN2:LCOD:OFFS 345` *RST value is 0

[:SOURce]:WCDMa:CHANnel<0...14>:SCODe:LMS #H0 to #HFF

The command determines the short code index used for the spreading of the long code mask symbols (LMS).

Example: `:SOUR:WCDM:CHAN2:SCOD:LMS #H3F` *RST value is #H1

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:POWer -30dB to 0dB

The command determines the power of a channel in relation to the power indication on the level display. Setting limitations are to be observed with respect to `:WCDM:MODE CHANx`.

Example: `:SOUR:WCDM:CHAN2:I:POW -22 DB` *RST value is -9

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:DATA PN9 | PN11 | PN15 | PN16 | DLISt

The command is used to determine the data source for the data field. PNx are PRBS data and DLISt data from a list previously defined. It is selected with the following command.

Example: `:SOUR:WCDM:CHAN2:I:DATA DLIS` *RST value is PN15

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:DATA:DLISt 'name'

The command selects the data list used with `:WCDM:CHAN:DATA DLIS`. The command has no *RST value.

Example: `:SOUR:WCDM:CHAN2:I:DATA:DLIS 'test2'`

[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:DATA:OFFSet 0 to 10239

The command is used to set the data offset (unit symbol duration). It shifts the modulation data with respect to the spread code.

Example: `:SOUR:WCDM:CHAN2:I:DATA:OFFS 345` *RST value is (<chan> * 3)

*RST value is 0 for channel 0, mode 8, downlink

[:SOURce]:WCDMa:CHANnel<1...14>:TPC ZERO | ONE | ALTernate | DLISt

The command determines the data source for the TPC field in channel types DPCH and DPCCh.

ZERO	0000..., sequence of zeros
ONE	1111..., sequence of ones
ALT	alternating sequence
DLISt	Data from a list previously defined.

Example: `:SOUR:WCDM:CHAN2:TPC DLIS` *RST value is ALT

[:SOURce]:WCDMa:CHANnel<1...14>:TPC:DLISt 'name

The command selects the data list used with `:WCDM:CHAN:TPC DLIS`. The command has no *RST value.

Example: `:SOUR:WCDM:CHAN2:TPC DLIS 'test1'`

[:SOURce]:WCDMa:CHANnel<0...14>:STATe ON | OFF

Switches the assigned code channel on or off.

Example: `:SOUR:WCDM:CHAN12:STAT ON` *RST value is ON

3.5.11.24 SOURce:W3GPp-Subsystem

Note: *#H0 to #HF are numerals which are entered in alphanumerical hex syntax in manual operation. SCPI (and IEEE 488.2) allow the octal and binary entry for non-decimal numbers in the following form*
#H|h <0 to 9, A|a to F|f>,
#Q|q <0 to 7> and
#B|b <0|1>.
However, the hex format is always used for the output generated by a query.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:W3GPp			
:STATe	ON | OFF		
:PRESet	(without)		
:GPP3			
:VERSion	V200 | V210		
:CRATe	R3M8 | R4M | R8M | R16M	(c/s)	
:LINK	FORWard | REVerse		
:SETTing			
:CATalog?	⇒ name {,name}		query only
:LOAD	'name'		
:STORe	'name'		
:DELete	'name'		
:PPARameter			
:PERCh	ON | OFF		only Forw. Link
:SCCPch			
:STATe	ON | OFF		only Forw. Link
:SRATe	D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M	(S/s)	only Forw. Link
:PRACh			
:STATe	ON | OFF		only Rev. Link
:SRATe	D16K | D32K | D64K | D128K	(S/s)	only Rev. Link
:DPCCh	ON | OFF		
:DPCH			
:COUNt	0 to 512		only Forw. Link
:DPDCh			
:COUNt	0 to 512		only Rev. Link
:SRATe	D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M	(S/s)	
:CRESt	MINimum | AVERage | WORSt		
:EXECute	(without)		
:SLENgth	1 to 12	Frames	
:COPY			
:SOURce	1 to 4		
:DESTination	1 to 4		
:SOFFset	0 to 2047		
:EXECute	(without)		

Command	Parameter	Default Unit	Remark
[:SOURce]			
:W3GPp			
:CLIPping			
:LEVel	1 to 100PCT	PCT	
:FILTer			
:TYPe	SCOSine | COSine | WCDMa		
:PARameter	0.1 to 0.7		
:MODE	LACP | LEVM		
:CRATe			
:VARiation	100Hz to 18MHz	Hz (c/s)	
:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger		
:TRIGger			
:SOURce	EXTernal | INTernal		
:INHibit	0 to 67108863	(chips)	
:DELay	0 to 40959 (163839)	(chips)	
:OUTPut[1]|2	SLOT | RFRame | CSPeriod		
:DELay	0 to 40959 (163839)	(chips)	
:POLarity	POSitive | NEGative		
:CLOCk			
:SOURce	INTernal | EXTernal		
:DELay	0 to 0.99	(symbols)	
:POWer?	(without)	dBm	query only
:ADJust			
:DOMain			
:ERRor			
[:STATe]?	-> 0 | 1		query only
:BMSTation<i>	with i = [1] | 2 | 3 | 4		
:STATe	ON | OFF		
:LCODe	#H0 to #H3FFFF (1FFFFFFFFFF for Rev. Link)		
:TSECtor	0 to 40959 (163839)	(chips)	
:SIGNature	0 to 16		only Rev. Link
:SOFFset	1 to 8		only Rev. Link
:TFCI	0 to 63		
:STATe	ON | OFF		
:SSCG	1 to 34		only Forw. Link
:POWer			
:OFFSet			
:PSCH	-10 to +10	dB	only Forw. Link
:SSCH	-10 to +10	dB	only Forw. Link
:TPC			
:MISuse	ON | OFF		
:POWer			
:STEP	-10 to +10	dB	
:TRANsmit			
:DIVersity	OFF | ANT1 | ANT2		only Forw. Link
:FBI	ZERO | ONE | PATTern		only Rev. Link
:PATTern	#H0 to #HFFFF (16Bit)		only Rev. Link
:MODE	OFF | BIT1 | BIT2		only Rev. Link

Command	Parameter	Default Unit	Remark
[:SOURce]			
:W3GPp			
:TPC	ZERO I ONE I PATTern		only Rev. Link
:PATTern	#H0 to #HFFFF (16Bit)		only Rev. Link
:MCHannel			
:EXECute	(without)		
:CHANnel<n>	with n = (0) I 2 to 129		
:SRATe	D8K I D16K I D32K I D64K I D128K I D256K I D512K I D1M I D2M I D4M	(S/s)	D8K only for Forw. Link
:SCODe	0 to 2047		
:POWer	-60 to 0	dB	
:DATA	PN9 I PN11 I PN15 I PN16 I ZERO I ONE I PATTern		
:PATTern	#H0 to #HFFFF		
:OFFSet	0 to 40959		
:TPC	ZERO I ONE I PATTern		only Forw. Link
:PATTern	#H0 to #HFFFF		only Forw. Link
:MCODe	ON I OFF		only Forw. Link
:STATe	ON I OFF		
:MCHannel			
:STARt	2 to 129		
:STOP	2 to 129		
:SRATe	D8K I D16K I D32K I D64K I D128K I D256K I D512K I D1M I D2M I D4M	(S/s)	D8K only for Forw. Link
:SCODe	0 to 2047		
:STEP	0 to 2047		
:POWer	-60 to 0	dB	
:STEP	-60 to +60	dB	
:DATA	PN9 I PN11 I PN15 I PN16 I ZERO I ONE I PATTern		
:PATTern	#H0 to #HFFFF		
:OFFSet	0 to 40959		
:STEP	0 to 40959		
:TPC	ZERO I ONE I PATTern		only Forw. Link
:PATTern	#H0 to #HFFFF		only Forw. Link
:MCODe	ON I OFF		only Forw. Link
:STATe	ON I OFF		

Note: *The calculation of the W-CDMA sequences is rather time-consuming and should be restarted for any new setting. The WCDMA modulation is therefore switched off for each command (autom.* `:W3GP:STAT OFF` *performed). The user can then perform several settings without any delay and has to switch on again the WCDMA modulation (with* `:W3GP:STAT ON`*). The calculations are performed and the previous settings are effective after the command is given.*

[:SOURce]:W3GPp:STATe ON | OFF

The command switches on the modulation in line with the W-CDMA procedure (ARIB standard). Option SMIQB45 is required for this purpose. All other standards that are switched on or the digital modulation are automatically switched to off state.

Caution: The command with ON should be used after any `:W3GP` command or after a series of W3GP commands in order to activate the previous settings.

Example: `:W3GP:STAT ON` (or `:SOUR:W3GP:STAT ON)` *RST value is OFF

[:SOURce]:W3GPp:PRESet

The command sets all the following settings to a defined initial state (as after *RST). This ensures that a signal is actually generated and that it is in line with the standard. This command triggers an event and hence has no *RST value and no query.

Example: `:W3GP:PRES`

[:SOURce]:W3GPp:GPP3:VERSion V200 | V210

The command sets the version. With V200, the pilot tables and long code generators of version 3GPP 2.0.0 are used, with V210 those of version 2.1.0.

Example: `:W3GP:GPP3:VERS V200` *RST value is V210

[:SOURce]:W3GPp:CRATe R3M8 | R4M | R8M | R16M

The command sets the chip rate (3.84M, 4.096M, 8.192M oder 16.384Mcps) ein.

Example: `:W3GP:CRAT R8M` *RST value is R4M

[:SOURce]:W3GPp:LINK FORWard | REVerse

The command selects the mode of the transmitted signal (sense of transmission). The signal either corresponds to that of a base station (forward) or a mobile station (reverse).

Example: `:W3GP:LINK REV` *RST value is FORW

[:SOURce]:W3GPp:SETTing:CATalog? ⇒name.

The command returns a list of all user-defined sequence configurations.

Example: `:W3GP:SETT:CAT?` Response: `'test1','test2'`

[:SOURce]:W3GPp:SETTing:LOAD 'name of sequence'

The command loads a user-defined sequence configuration. The name may have a maximum number of 8 characters. This command triggers an action and hence has no *RST value.

Example: `:W3GP:SETT:LOAD 'test'`

[:SOURce]:W3GPp:SETTing:STORe 'name of sequence'

The command stores a current sequence configuration under a name. The name may contain a maximum of 8 letters. This command triggers an action and so has no *RST value and no query.

Example: `:W3GP:SETT:STOR 'test'`

[:SOURce]:W3GPp:SETTing:DELete 'name of sequence'

The command deletes the specified sequence configuration. This command triggers an action and so has no *RST value and no query.

Example: `:W3GP:SETT:DEL 'test1'`

[:SOURce]:W3GPp:PPARameter

The commands for the parameterizable predefined settings are under this node. The channel table is filled (preset) with the following parameters, if the `:W3GP:PPAR:EXEC` action command is executed.

[:SOURce]:W3GPp:PPARameter:PERCh ON | OFF

Perch is used in the scenario (ON) or remains unused (OFF). This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:PPAR:PERC OFF` *RST value is ON

[:SOURce]:W3GPp:PPARameter:SCCPch:STATe ON | OFF

SCCPCH is used in the scenario (ON) or remains unused (OFF). This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:PPAR:SCCP:STAT OFF` *RST value is ON

[:SOURce]:W3GPp:PPARameter:SCCPch:SRATe D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M

The transmission rate of the SCCPCH is set.
This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:PPAR:SCCP:SRATE D128K` *RST value is D64K

[:SOURce]:W3GPp:PPARameter:PRACh:STATe ON | OFF

PRACH is used in the scenario (ON) or remains unused (OFF). This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:PPAR:PRAC:STAT ON` *RST value is OFF

[:SOURce]:W3GPp:PPARameter:PRACh:SRATe D16K | D32K | D64K | D128K

The transmission rate of PRACH is set. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:PPAR:PRAC:SRATE D128K` *RST value is D16K

[:SOURce]:W3GPp:PPARameter:DPCCh ON | OFF

DPCCH is used in the scenario (ON) or remains unused (OFF).

Example: `:W3GP:PPAR:DPCC OFF` *RST value is ON

[:SOURce]:W3GPp:PPARameter:DPCH:COUNt 0 to 512

The command sets the number of DPCH channels. The maximum number depends on the chip rate and the symbol rate. This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:PPAR:DPCH:COUN 16` *RST value is 3

[:SOURce]:W3GPp:PPARameter:DPDCh:COUNt 0 to 512

The command sets the number of DPDCH channels. The maximum number depends on the chip rate and the symbol rate. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:PPAR:DPDC:COUN 16` *RST value is 3

[:SOURce]:W3GPp:PPARameter:SRATe D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M

The command sets the symbol rate of the DPDCH and DPCH channels from 8 ksymb/s to 4096 ksymb/s. D8K is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:PPAR:SRAT D1M` *RST value is D32K

[:SOURce]:W3GPp:PPARameter:CRESt MINimum | AVERage | WORSt

The command sets the crest factor. MIN sets the data offset and spreading code so that they are minimized. An average value is generated with AVG, the highest value of the crest factor with MAX.

Example: `:W3GP:PPAR:CRES WORS` *RST value is MIN

[:SOURce]:W3GPp:PPARameter:EXECute

This action command fills (presets) the channel table with the above parameters.

Example: `:W3GP:PPAR:EXEC`

[:SOURce]:W3GPp:SLENgth 1 to 12

The command defines the length of the calculated chip sequence as a number of frames.

Example: `:W3GP:SLEN 8` *RST value is 1

[:SOURce]:W3GPp:COPY

The commands for copying the setting of a mobile or base station (MBSTation) to the data record of another are under this node. The `:W3GP:COPY:EXEC` command starts copying.

[:SOURce]:W3GPp:COPY:SOURce 1 to 4

The command selects the station whose data are to be copied.

Example: `:W3GP:COPY:SOUR 2`

[:SOURce]:W3GPp:COPY:DESTination 1 to 4

The command selects the station to which data are to be copied.

Example: `:W3GP:COPY:DEST 3`

[:SOURce]:W3GPp:COPY:SOFFset 0 to 2047

The command sets the offset value for the spreading code in the target station.

Example: `:W3GP:COPY:SOFF 100`

[:SOURce]:W3GPp:COPY:EXECute

The command starts copying.

Example: `:W3GP:COPY:EXEC`

[:SOURce]:W3GPp:CLIPping:LEVel 1 to 100PCT |

The command limits the output level (referred to the unlimited level).

Example: `:W3GP:CLIP:LEV 95`

[:SOURce]:W3GPp:FILTer:TYPe SCOSine I COSine I WCDMa

The command selects the type of filter.

SCOSine	Square root cosine (root Nyquist) filter
COSine	Cosinus (Nyquist) filter
WCDMa	Root Nyquist filter with fixed roll-off factor 0.22

Example: `:W3GP:FILT:TYP COS` *RST value is WCDM

[:SOURce]:W3GPp:FILTer:PARameter 0.1 to 0.7

The command sets the roll-off factor for the COS and SCOS filters.

Example: `:W3GP:FILT:PAR 0.5` *RST value is 0.22

[:SOURce]:W3GPp:FILTer:MODE LACP I LEVM

This command selects one of the "L"ow filter modes (LACP: lowest adjacent channel power, LEVM: lowest error vector).

Example: `:W3GP:FILT:MODE LEVM` *RST value is LACP

[:SOURce]:W3GPp:CRATe:VARiation 100 Hz to 18 MHz (cps)

The command selects the variation for the chip rate frequency (as against that set with `:W3GP:CRAT`).

Example: `:W3GP:CRAT:VAR 1.2MHz` *RST value is 4.096M

[:SOURce]:W3GPp:SEQuence AUTO I RETRigger I AAUTo I ARETrigger

The command selects the trigger mode for the W-CDMA sequence.

AUTO	Continuously repeated
RETRigger	Continuously repeated; new start after a trigger
AAUTo	ARMED AUTO; waits for trigger, then switches over to AUTO and can no longer be triggered
ARETrigger	ARMED RETRIG; a trigger event is required to start, each new trigger causes a restart

Example: `:W3GP:SEQ AAUT` *RST value is RETR

[:SOURce]:W3GPp:TRIGger:SOURce EXTernal I INTernal

The command selects the trigger source. With INT selected, triggering is via remote control using the trigger command or via EXECUTE TRIGGER in case of manual control.

EXT	The trigger signal is fed in via input TRIGIN
INT	A start is only possible manually or via the remote control command `TRIG:DM:IMM`

Example: `:W3GP:TRIG:SOUR EXT` *RST value is INT

[:SOURce]:W3GPp:TRIGger:INHibit 0 to 67108863

The command sets the retrigger inhibit duration (in number of chips).

Example: `:W3GP:TRIG:INH 1000` *RST value is 0

[:SOURce]:W3GPp:TRIGger:DELay 0 to 40959

The command defines the trigger delay (in number of chips).

Example: `:W3GP:TRIG:DEL 200` *RST value is 0

[:SOURce]:W3GPp:TRIGger:OUTPut[1]|2 SLOT | RFRame | CSPeriod

The command defines the output signal at trigger output 1 or 2. The following times can be selected:

SLOT	Time slot clock
RFRame	Radio Frame (frame clock)
CSPeriod	Chip Sequence Period

Example: `:W3GP:TRIG:OUTP RFR` *RST value is: for OUTPut 1: RFR
for OUTPut 2: CSP

[:SOURce]:W3GPp:TRIGger:OUTPut[1]|2:POLarity POSitive | NEGative

The commands defines the polarity of the signals at the trigger outputs.

Example: `:W3GP:TRIG:OUTP2:POL NEG` *RST value is POS

[:SOURce]:W3GPp:TRIGger:OUTPut[1]|2:DELay 0 to 40959 (81919)

The command defines the delay of trigger signals in chips.

Example: `:W3GP:TRIG:OUTP2:DEL 50` *RST value is 0

[:SOURce]:W3GPp:CLOCk:SOURce INTernal | EXTernal

The command selects the clock source.

INTernal	The internal clock generator is used.
EXTernal	The clock is fed externally via connector SYMBOL CLOCK.

Example: `:W3GP:CLOC:SOUR EXT` *RST value is INT

[:SOURce]:W3GPp:CLOCk:DELay 0 to 0.99

The command sets the delay of the clock signal in chips.

Example: `:W3GP:CLOC:DEL 0.5` *RST value is 0

[:SOURce]:W3GPp:POWer?

The command queries the total power for the W-CDMA signal.

Example: `:W3GP:POW?`

[:SOURce]:W3GPp:POWer:ADJust

The command changes the power of the activated code channels. The total power then equals the power shown by the Level display (total power). This command triggers an action and so has no *RST value and no query form.

Example: `:W3GP:POW:ADJ`

[:SOURce]:W3GPp:DOMain:ERRor[:STATe]?

The command asks whether there is a conflict in the hierarchically structured spreading codes (response 1) or not (response 0). The cause can be pin-pointed with the manual control.

Example: `:W3GP:DOM:ERR?`

[:SOURce]:W3GPp:BMSTation<i> with i = [1] | 2 | 3 | 4

Separate commands for one of the 4 base stations or one for the 4 mobile stations are under this node. Whether the commands apply to the mobile or base station has to be set beforehand by means of the link direction (mobile station: `:W3GP:LINK REV`, base station: `:W3GP:LINK FORW`).

[:SOURce]:W3GPp:BMSTation<i>:STATe ON | OFF

The command activates the station using ON and deactivates it with OFF.

Example: `:W3GP:BMST2:STAT ON` *RST value is ON (for BMST1), OFF (for 2 to 4)

[:SOURce]:W3GPp:BMSTation<i>:LCODe #H0 to #H3FFFFF (1FFFFFFFFFF)

The command sets the initial value of the long code for a station.

Example: `:W3GP:BMST:LCOD #H1234` *RST value is #H1000 (for BMST1)
#H2000 (for BMST2)
#H3000 (for BMST3)
#H4000 (for BMST4)

[:SOURce]:W3GPp:BMSTation<i>:TSECtor 0 to 40959 (163839)

The command sets the long code offset in chips for a station. The maximum value equals (chip rate/100)-1.

Example: `:W3GP:BMST2:TSEC 345` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:SIGNature 0 to 16

The command sets the value for the signature of the CPCH (PRACH). This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST4:SIGN 10` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:SOFFset 0 to 15

The command sets the starting time shift for the CPCH (PRACH). This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST3:SOFF 10` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:TFCI 0 to 63

The command sets the value of the transport format identifier (DPCH).

Example: `:W3GP:BMST2:TFCI 22` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:TFCI:STATe ON | OFF

The command activates the transport format identifier (ON) or deactivates it (OFF).

Example: `:W3GP:BMST3:TFCI:STAT ON` *RST value is OFF

[:SOURce]:W3GPp:BMSTation<i>:SSCG 1 to 34

The command sets the 2nd search code group (PERCH). This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:BMST4:SSCG 33` *RST value is 1 (for BMST1)
2 (for BMST2)
3 (for BMST3)
4 (for BMST4)

[:SOURce]:W3GPp:BMSTation<i>:POWer:OFFSet:PSCH -10.0 to 10.0 dB

The command sets the power offset for the P-SCH component of the perch channel relative to the channel power of the perch. This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:BMST:POW:OFFS:PSCH -6` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:POWer:OFFSet:SSCH -10.0 to 10.0 dB

The command sets the power offset for the S-SCH component of the perch channel relative to the channel power of the perch. This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:BMST:POW:OFFS:SSCH -6` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:TPC:MISuse ON | OFF

The command sets the misuse of the TPC pattern of each channel for the channel power control.

Example: `:W3GP:BMST:TPC:MIS ON` *RST value is OFF

[:SOURce]:W3GPp:BMSTation<i>:TPC:POWer:STEP -10.0 to 10.0 dB

The command sets the channel-power stepwidth when option `:W3GP:BMST:MIS:TPC ON` is active.

Example: `:W3GP:BMST:TPC:POW:STEP 3.1` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:TRANsmit:DIVersity OFF | ANT1 | ANT2

This command sets the calculation of the signal without transmit diversity (OFF) or for antenna 1, or antenna 2 (SCH channels with TSTD mode, other channels with STTD mode). This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:BMST:TRAN:DIV ANT2` *RST value is OFF

[:SOURce]:W3GPp:BMSTation<i>:FBI ZERO | ONE | PATTern

The command selects the data source for the FBI field. ZERO continuously generates 0 data; ONE generates 1 data. PATT uses the data specified by the `:W3GP:BMST:FBI:PATT` command. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST:FBI PATT` *RST value is ZERO

[:SOURce]:W3GPp:BMSTation<i>:FBI:PATTern #H0 to HFFFF

The command selects the data pattern for the FBI field, for the setting `:W3GP:BMST:FBI PATT`. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST:FBI:PATT #H3F` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:FBI:MODE OFF | BIT1 | BIT2

The command defines the use of the FBI field in the frame. It is not used when OFF is set. With BIT1 set, it is1 bit long and with BIT2 set it is 2 bits long. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST:FBI:MODE` *RST value is OFF

[:SOURce]:W3GPp:BMSTation<i>:TPC ZERO | ONE | PATTern

The command selects the data source for the TPC field (valid for DPCCH). ZERO continuously generates 0 data, ONE generates 1 data. PATT uses the data specified with the `:W3GP:BMST:TPV:PATT` command. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST:TPC PATT` *RST value is ZERO

[:SOURce]:W3GPp:BMSTation<i>:TPC:PATTern #H0 to #HFFFF

The command selects the data pattern for the TPC field for the setting `:W3GP:BMST:TPC PATT`. This command is only available with `:W3GP:LINK REV`.

Example: `:W3GP:BMST2:TPC:PATT #HAAAA` *RST value is #0H

[:SOURce]:W3GPp:BMSTation<i>:MCHannel:EXECute

All channels with the numbers between start and stop are simultaneously set to the value of the `:W3GP:MCH` commands above using this action command.

Example: `:W3GP:BMST3:MCH:EXEC`

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n> with n = (0) | 2 to 129

The commands for specifying the channel configuration of the DPCH/DPDCH channels are under this node. Channels 0 and 1 are preassigned according to the following table:

Channel	Link Forward (Base station)	Link Reverse (Mobil station)
0	PERCH	CPCH
1	CPCH	DPCCH
2 to 129	DPCH	DPDCH

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:SRATe D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M

This command defines the symbol rate. D8K is only available with `:W3GP:LINK FORW`.

Only with this command is channel 0 (:CHAN0 is permitted) settable to the two possible values D32K (slow mode) and D128K (fast mode) under `:W3GP:LINK REV`.

Example: `:W3GP:BMST:CHAN2:SRAT D64K` *RST value is D32K

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:SCODe 0 to 2047

This command sets the spreading code. The upper limit depends on `:W3GP:CRAT`, `:W3GP:SRAT` and on the type of channel.

Example: `:W3GP:BMST1:CHAN3:SCOD 123` *RST value is (mostly 0; cf. manual oper.)

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:POWer –60 dB to 0 dB

This command defines the power weighting factor of a channel relative to the power shown by the LEVEL display.

Example: `:W3GP:BMST2:CHAN4:POW -22DB` *RST value is 0

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:DATA PN9 | PN11 | PN15 | PN16 | ZERO | ONE | PATTern

This command defines the data source for the data field. PNx is PRBS data and PATT is a pattern which is set with the following command. ZERO sets all bits to 0, ONE sets all bits to 1.

Example: `:W3GP:BMST3:CHAN5:DATA PATT` *RST value is PN15

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:DATA:PATTern #H0 to #HFFFF

This command sets the pattern which is used under `:W3GP:BMST:CHAN:DATA PATT`.

Example: `:W3GP:BMST:CHAN2:DATA:PATT #H5555` *RST value is #H0

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:DATA:OFFSet 0 to 10239

This command sets the data offset (unit: symbol duration). It offsets the modulation data with respect to the long code.

Example: `:W3GP:BMST2:CHAN6:DATA:OFFS 345` *RST value is (<chan> * 3)

*RST value is 0 for channel 0, mode 8, Downlink

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:TPC ZERO | ONE | PATTern

This command defines the data source for the TPC field in DPCHs. This command is only available with `:W3GP:LINK FORW`.

ZERO	0000, sequence of zeros
ONE	1111 , sequence of ones
PATTern	the bit pattern set with the following command

Example: `:W3GP:BMST3:CHAN7:TPC PATT` *RST value is ZERO

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:TPC:PATTern #H0 to #HFFFF

This command sets the bit pattern which is used under `:W3GP:BMST:CHAN:TPC PATT`. This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:BMST4:CHAN2:TPC:PATT #H5555` *RST value is #H0

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:MCODe ON | OFF

The command switches the multicode for the channel on or off. This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:BMST:CHAN3:MCOD ON` *RST value is OFF

[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:STATe ON | OFF

The command switches the assigned code channel on or off.

Example: `:W3GP:BMST2:CHAN4:STAT OFF` *RST value is ON

[:SOURce]:W3GPp:MCHannel

The commands for the common setting of several DPCH/DPDCH channels are under this node (multichannel). All channels with the numbers between start and stop are simultaneously set to the value of the following commands by means of the `:W3GP:BMST<i>:MCH:EXEC` action command.

[:SOURce]:W3GPp:MCHannel:STARt 2 to 129

The command specifies the initial channel of the group with common setting.

Example: `:W3GP:MCH:STAR 2` *RST value is 2

[:SOURce]:W3GPp:MCHannel:STOP 2 to 129

The command specifies the end channel of the group with common setting.

Example: `:W3GP:MCH:STOP 129` *RST value is 2

[:SOURce]:W3GPp:MCHannel:SRATe D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M

This command defines the symbol rate. The possible values depend on `:W3GP:LINK` and the chip rate. D8K is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:MCH:SRAT D64K` *RST value is D32K

[:SOURce]:W3GPp:MCHannel:SCODe 0 to 2047

This command sets the spreading code. The upper limit depends on `:W3GP:CRAT` and `:W3GP:SRAT` and is only valid for DPDCH and DPCH.

Example: `:W3GP:MCH:SCOD 123` *RST value is (mostly 0; cf. manual oper.)

[:SOURce]:W3GPp:MChannel:SCODe:STEP 0 to 2047

This command sets the spreading code/step width. The upper limit depends on `:W3GP:CRAT` and `:W3GP:SRAT` and is only valid for DPDCH and DPCH.

Example: `:W3GP:MCH:SCOD:STEP 123` *RST value is 0

[:SOURce]:W3GPp:MChannel:POWer –60 dB to 0 dB

This command defines the power weighting factor of a channel relative to the power displayed by the LEVEL display.

Example: `:W3GP:MCH:POW -22DB` *RST value is 0 dB

[:SOURce]:W3GPp:MChannel:POWer:STEP –60 dB to +60 dB

This command defines the stepwidth of the power weighting factor of a channel relative to the power displayed by the LEVEL display.

Example: `:W3GP:MCH:POW:STEP -22DB` *RST value is 0 dB

[:SOURce]:W3GPp:MChannel:DATA PN9 I PN11 I PN15 I PN16 I ZERO I ONE I PATTern

This command defines the data source for the data field. PNx is PRBS data and PATT is a pattern which is set with the following command. ZERO sets all bits to 0, ONE sets all bits to 1.

Example: `:W3GP:MCH:DATA PATT` *RST value is PN15

[:SOURce]:W3GPp:MChannel:DATA:PATTern #H0 to #HFFFF

This command sets the pattern which is used under `:W3GP:BMST3:MCH:DATA PATT`.

Example: `:W3GP:MCH:DATA:PATT #H5555` *RST value is #H0

[:SOURce]:W3GPp:MChannel:DATA:OFFSet 0 to 40959

This command sets the data offset (unit: symbol duration). It offsets the modulation data with respect to the long code.

Example: `:W3GP:MCH:DATA:OFFS 345` *RST value is 0

[:SOURce]:W3GPp:MChannel:DATA:OFFSet:STEP 0 to 40959

This command sets the stepwidth of the data offset (unit: symbol duration). It offsets the modulation data with respect to the long code.

Example: `:W3GP:MCH:DATA:OFFS:STEP 345` *RST value is 0

[:SOURce]:W3GPp:MChannel:TPC ZERO I ONE I PATTern

This command defines the data source for the TPC field in DPCHs. This command is only available with `:W3GP:LINK FORW`.

ZERO	0000, sequence of zeros
ONE	1111, sequence of ones
PATTern	the bit pattern set with the following command

Example: `:W3GP:MCH:TPC PATT` *RST value is ZERO

[:SOURce]:W3GPp:MChannel:TPC:PATTern #H0 to #HFFFF

This command sets the bit pattern which is used under `:W3GP:BMST3:MCHan:TPC PATT`. This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:MCH:TPC:PATT #H5555` *RST value is #H0

[:SOURce]:W3GPp:MCHannel:MCODe ON | OFF

The command activates the multicode for the channel (ON) or deactivates it (OFF). This command is only available with `:W3GP:LINK FORW`.

Example: `:W3GP:MCH:MCOD ON` *RST value is OFF

[:SOURce]:W3GPp:MCHannel:STATe ON | OFF

The command activates the code channels (ON) or deactivates them (OFF).

Example: `:W3GP:MCH:STAT OFF` *RST value is ON

3.5.12 SOURce2 System

The SOURce2 system contains the commands to configure the LF signal source. It is designated as INT if used as a modulation source (cf. command `SOURce:AM:SOURce INT`, e.g.).T

The commands to set the output voltage of the LF generators are in the OUTPut2 system.

Subsystems	Settings
:SOURce2	
:FREQuency	Frequency with CW and sweep operation.
:MARKer	Marker for LF sweeps (only possible using SOURce2)
:SWEep	LF sweep (only possible using SOURce2)

3.5.12.1 SOURce2:FREQuency Subsystem

This subsystem contains the commands for the frequency settings in operating modes CW and SWEep for the LF generator.

Command	Parameter	Default Unit	Remark
:SOURce2			
:FREQuency			
[:CW|:FIXed]	0.1 Hz to 1 MH	Hz	
:MANual	0.1 Hz to 1 MHz	Hz	
:MODE	CW|FIXed | SWEep		
:STARt	0.1 Hz to 1 MHz	Hz	
:STOP	0.1 Hz to 1 MHz	Hz	

:SOURce2:FREQuency[:CW | :FIXed] 0.1 Hz to 1 MHz

The command sets the frequency for the CW mode. *RST value is 1 kHz

Example: `:SOUR2:FREQ:CW 1kHz`

:SOURce2:FREQuency:MANual 0.1 Hz to 1 MHz

The command sets the frequency if `:SOURce2:SWEep:MODe MANual` and `SOURce2:FREQuency:MODe SWEep` are set. In this case, only frequency values between the settings `SOURce2:FREQuency:STARt` and `...:STOP` are allowed.

Example: `:SOUR2:FREQ:MAN 1kHz` *RST value is 1kHz

:SOURce2:FREQuency:MODE CW|FIXed | SWEep

The command specifies the operating mode and hence by means of which commands the FREQuency subsystem is checked. The following allocations are valid:

CW |FIXed	CW and FIXed are synonyms. The output frequency is specified by means of `SOURce2:FREQuency:CW |FIXed`.
SWEep	The generator operates in the SWEep mode. The frequency is specified by means of commands `SOURce2:FREQuency:STARt; STOP; MANual`.
Example:	`:SOUR2:FREQ:MODE CW` *RST value is CW

:SOURce2:FREQuency:STARt 0.1 Hz to 1 MHz

This command indicates the starting value of the frequency for the sweep.

Example: `:SOUR2:FREQ:STAR 100kHz` *RST value is 1kHz

:SOURce2:FREQuency:STOP 0.1 Hz to 1 MHz

This command indicates the end value of the frequency for the sweep.

Example: `:SOUR2:FREQ:STOP 200kHz` *RST value is 100 kHz

3.5.12.2 SOURce2:MARKer-Subsystem

This subsystem contains the commands to check the marker generation in the case of LF sweeps. The three markers existing are differentiated by a numeric suffix after marker.

Command	Parameter	Default Unit	Remark
:SOURce2			Option SM-B2/B6
:MARKer1|2|3			
[:FSWeep]			
:AOFF			No query
:FREQuency	0.1 Hz to 1 MHz	Hz	
[:STATe]	ON | OFF		
:POLarity	NORMal | INVerted		

:SOURce2:MARKer1|2|3[:FSWeep]

The commands for the markers with the LF frequency sweep (Frequency SWeep) are under this node. Keyword [:FSWeep] can also be omitted, then the command conforms to SCPI regulation (see examples).

:SOURce2:MARKer1|2|3[:FSWeep]:AOFF

The command switches off all LF frequency markers. This command triggers an event, thus is has no *RST value and no query form.

Example: `:SOUR2:MARK:AOFF`

:SOURce2:MARKer1|2|3[:FSWeep]:FREQuency 0.1 Hz to 1 MHz

The command sets the marker selected by the numeric suffix at MARKer to the frequency indicated.

*RST value for MARK1: 100kHz
MARK2: 10kHz
MARK3: 1kHz

Example: `:SOUR2:MARK1:FREQ 9000`

:SOURce2:MARKer1|2|3[:FSWeep][:STATe] ON | OFF

The command switches on or off the marker selected by the numeric suffix at MARKer.

Example: `:SOUR2:MARK1:STAT ON` *RST value is OFF

:SOURce2:MARKer1|2|3:POLarity NORMal | INVerted

The command specifies the polarity of the marker signal as follows:

NORMal	When running through the marker condition, TTL level is applied at the marker output, otherwise 0 V.
INVers	When running through the marker condition, 0 V is applied at the marker output, otherwise TTL level. *RST value is NORM

Example: `:SOUR2:MARK1:POL INV`

3.5.12.3 SOURce2:SWEep-Subsystem

This subsystem contains the commands to check the LF sweep of SOURce2. Sweeps are triggered on principle.

Command	Parameter	Default Unit	Remark
:SOURce2			Option SM-B2
:SWEep			
:BTIMe	NORMal | LONG		
[:FREQuency]			
:DWELl	1 ms to 1 s	s	
:MODE	AUTO | MANual | STEP		
:POINts	Number		
:SPACing	LINear | LOGarithmic		
:STEP			
[:LINear]	0 to 500 kHz	Hz	
:LOGarithmic	0.01 PCT to 50 PCT	PCT	

:SOURce2:SWEep:BTIMe NORMal | LONG

The command sets the blank time (<u>B</u>lank <u>TIMe</u>) of the sweep. The setting is valid for all sweeps, i.e., also for RF sweeps

NORMal Blank time as short as possible.

LONG Blank time long enough to permit an X/Y recorder to return to 0.

Example: `:SOUR2:SWE:BTIM LONG` *RST value is NORM

:SOURce2:SWEep[:FREQuency]

The commands to set the frequency sweeps are under this node. Keyword [:FREQuency] can be omitted. Then the commands are SCPI-compatible unless stated otherwise (see examples).

:SOURce2:SWEep[:FREQuency]:DWELl 1 ms to 1 s

The command sets the time per frequency step (dwell).

Example: `:SOUR2:SWE:DWEL 20ms` *RST value is 15 ms

:SOURce2:SWEep[:FREQuency]:MODE AUTO | MANual | STEP

The command specifies the run of the sweep.

AUTO Each trigger triggers exactly one entire sweep cycle.

STEP Each trigger triggers only one sweep step (single-step mode). The frequency increases by the value indicated under `:SOURce2:SWEep`

Example: `:SOUR2:SWE:MODE AUTO` *RST value is AUTO

:SOURce2:SWEep[:FREQuency]:POINts Number

The command determines the number of steps in a sweep. Instead of this command, commands `:SOURce2:FREQuency:STEP:LINear` and `:SOURce2 :FREQuency:STEP:LOGarithmic` should be used, as `:SOURce2:SWEep:FREQuency: POINts` has been adapted to the instrument characteristics in comparison to the SCPI command. The value of POINts depends on SPAN and STEP according to the following formulas.

The following is true of linear sweeps : POINts = SPAN / STEP:LIN + 1

The following is true of logarithmic sweeps and STARt < STOP:

POINts = ((log STOP log STARt) / log STEP:LOG) + 1

Two independent POINts values are used for SPACing LOG and SPACing LIN. That is to say, before POINts is changed, SPACing must be set correctly. A change of POINts causes an adaption of STEP, but not of STARt, STOP and SPAN.

Example: `:SOUR2:SWE:POIN 50`

:SOURce2:SWEep[:FREQuency]:SPACing LINear I LOGarithmic

The command selects whether the steps have linear or logarithmic spacings.

Example: `:SOUR2:SWE:SPAC LOG` *RST value is LINear

:SOURce2:SWEep[:FREQuency]:STEP

The commands to set the step width with linear and logarithmic sweeps are under this node. The settings of STEP:LIN and STEP:LOG are independent of each other.

:SOURce2:SWEep[:FREQuency]:STEP[:LINear] 0 to 500 kHz

The command sets the step width with the linear sweep. If STEP:LINear is changed, the value of POINts valid for SPACing:LINear also changes according to the formula indicated under POINts. A change of SPAN does not cause a change of STEP:LINear. Keyword [:LINear] can be omitted, then the command conforms to SCPI regulation (see example)

Example: `:SOUR2:SWE:STEP 10kHz` *RST value is 1 kHz

:SOURce2:SWEep[:FREQuency]:STEP:LOGarithmic 0.01 to 50PCT

The command indicates the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated according to (if STARt < STOP) :

new frequency = prior frequency + STEP:LOG x prior frequency

Thus STEP:LOG indicates the fraction of the prior frequency by which this is increased for the next sweep step. Usually STEP:LOG is indicated in percent, with the suffix PCT having to be used explicitly. If STEP:LOG is changed, the value of POINts valid for SPACing:LOGarithmic also changes according to the formula stated unde

Example: `:SOUR2:SWE:STEP:LOG 5PCT` *RST value is 1 PCT

3.5.13 STATus-System

This system contains the commands for the status reporting system (c.f. Section "Status Reporting System"). *RST has no influence on the status registers.

Command	Parameter	Default Unit	Remark
:STATus			
:OPERation			
[:EVENt]?			Query only
:CONDition?			Query only
:PTRansition	0 to 32767		
:NTRansition	0 to 32767		
:ENABle	0 to 32767		
:PRESet			No query
:QUEStionable			
[:EVENt]?			Query only
:CONDition?			Query only
:PTRansition	0 to 32767		
:NTRansition	0 to 32767		
:ENABle	0 to 32767		
:QUEue			
[:NEXT]?			Query only

:STATus:OPERation

The commands for the STATus:OPERation register are under this node.

:STATus:OPERation[:EVENt]?

The command queries the content of the EVENt part of the STATus:OPERation register. In reading out, the content of the EVENt part is deleted.

Example: `:STAT:OPER:EVEN?` Response: `17`

:STATus:OPERation:CONDition?

The command queries the content of the CONDition part of the STATus:OPERation register. In reading out, the content of the CONDition part is not deleted. The value returned directly reflects the current hardware state.

Example: `:STAT:OPER:COND?` Response: `1`

:STATus:OPERation:PTRansition 0 to 32767

The command (Positive TRansition) sets the edge detectors of all bits of the STATus:OPERation register from 0 to1 for the transitions of the CONDition bits.

Example: `:STAT:OPER:PTR 32767`

:STATus:OPERation:NTRansition 0 to 32767

The command (Negative TRansition) sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Example: `:STAT:OPER:NTR 0`

:STATus:OPERation:ENABle 0 to 32767

The command sets the bits of the ENABle register. This register selectively enables the individual events of the appropriate status event register for the sum bit in the status byte.

Example: `:STAT:OPER:ENAB 1`

:STATus:PRESet

The command resets the edge detectors and ENABle parts of all registers to a defined value. All PTRansition parts are set to FFFFh, i.e., all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e., a transition from 1 to 0 in a CONDition bit is not detected. The ENABle parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e., all events in these registers are not passed on.

Example: `:STAT:PRES`

:STATus:QUEStionable

The commands for the STATus:QUEStionable register are under this node.

:STATus:QUEStionable[:EVENt]?

The command queries the content of the EVENt part of the STATus:QUEStionable register. In reading out, the content of the EVENt part is deleted.

Example: `:STAT:QUES:EVEN?` Response: `1`

:STATus:QUEStionable:CONDition?

The command queries the content of the CONDition part of the STATus:QUEStionable register. In reading out, the content of the CONDition part is not deleted.

Example: `:STAT:QUES:COND?` Response: `2`

:STATus:QUEStionable:PTRansition 0 to 32767

The command (Positive TRansition) sets the edge detectors of all bits of the STATus:QUEStionable register from 0 to 1 for transitions of the CONDition bit.

Example: `:STAT:QUES:PTR 32767`

:STATus:QUEStionable:NTRansition 0 to 32767

The command (Negative TRansition) sets the edge detectors of all bits of the STATus:QUEStionable register from 1 to 0 for transitions of the CONDition bit.

Example: `:STAT:QUES:NTR 0`

:STATus:QUEStionable:ENABle 0 to 32767

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This part selectively enables the individual events of the appropriate EVENt part for the sum bit in the status byte

Example: `:STAT:QUES:ENAB 1`

:STATus:QUEue[:NEXT]?

The command queries the entry that has been in the error queue for the longest time and thus deletes it. Positive error numbers denote errors specific of the instrument, negative error numbers error messages specified by SCPI (see annex B). If the error queue is empty, 0, "No error", is returned. The command is identical to SYSTem :ERRor?

Example: `STATus:QUEue:NEXT?` Response: `-221, "Settings conflict"`

3.5.14 SYSTem-System

In this system, a number of commands for general functions which are not immediately related to signal generation, are combined.

Command	Parameter	Default Unit	Remark
:SYSTem			
:BEEPer			
:STATe	ON I OFF		
:COMMunicate			
:GPIB			
:LTERminator	EOI I STANdard		
[:SELF]			
:ADDRess	0 to 30		
:SDATa			
:BAUD	1200 I 2400 I 4800 I 9600 I 19200 I 38400 I 57600 I 115200		
:SERial			
:CONTrol			
:RTS	ON I IBFull I RFR		
:BAUD	1200 I 2400 I 4800 I 9600 I 19200 I 38400 I 57600 I 115200		
:PACE	XON I NONE		
:ERRor?			Query only
:KLOCk	ON I OFF		
:MODE	FIXed I MSEQuence		
:MSEQuence			
:CATalog?			Query only
:DELete	"Name of sequence"		
:ALL			
:DWELl	50 ms to 60 s {,50 ms to 60 s}	s	
:FREE?			
:MODE	AUTO I STEP		
[:RCL]	1 to 50 {,1 to 50}		
:POINts?			Query only
:SELect	"Name of sequence"		
:PRESet			No query
:PROTect1I2I3			
[:STATe]	ON I OFF , password		
:SECurity			
[:STATe]	ON I OFF		
:SERRor?			Query only
:VERSion?			Query only
:SSAVe	1 to 1000		
:SREStore	1 to 1000		
!	<least significant byte> <most significant byte>		

:SYSTem:BEEPer:STATe ON | OFF

This node contains the commands to set the beeper fitted. *RST value is OFF

Example: `:SYST:BEEP:STAT OFF`

:SYSTem:COMMunicate:GPIB

The commands to check the IEC bus are under this node (GPIB = General Purpose Interface Bus)

:SYSTem:COMMunicate:GPIB:LTERminator EOI | STANdard

The command activates the delimiter identification mode.

EOI	only signs transmitted with the circuit message EOI are identified. The EOI mode is particularly suitable for binary block transmission where an arbitrary sign not representing a delimiter could accidentally have the value LF
STANdard	LF (with or without EOI) is identified as a delimiter as well.

Example: `:SYST:COMM:GPIB:LTER EOI` *RST value is STAN

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 1 to 30

The command sets the IEC bus instrument address. *RST value is 28

Example: `:SYST:COMM:GPIB:ADDR 1`

:SYSTem:COMMunicate:SDATa:BAUD 1200| 2400| 4800| 9600| 19200| 38400| 57600| 115200

The commands sets the baud rate for the asynchronous data (connector SERDATA) for digital modulation and digital standards.. *RST has no influence on this parameter.

Example: `:SYST:COMM:SDAR:BAUD 1200` *RST value is 9600

:SYSTem:COMMunicate:SERial

The command to set the serial interface are under this node. The data format is fixedly set to 8 data bits, no parity and 1 stop bit. These values cannot be changed. The device represents a DTE (Data Terminal Equipment) in relation to the serial interface. Therefore the the controller must be connected via a 0-modem.

:SYSTem:COMMunicate:SERial:BAUD 1200| 2400| 4800| 9600| 19200| 38400| 57600| 115200

The commands sets the baud rate for both the transmit and the receive direction. *RST has no influence on this parameter.

Example: `:SYST:COMM:SER:BAUD 1200` *RST value is 9600

:SYSTem:COMMunicate:SERial:CONTrol:RTS ON | IBFull | RFR

he commands sets the hardware handshake. *RST has no influence on this parameter.

ON	Interface line RTS is always active.
IBFull | RFR	Input Buffer Full | Ready For Receiving. Interface line RTS remains active as long as the instrument is ready to receive data

Example: `:SYST:COMM:SER:CONT:RTS ON` *RST value is RFR

:SYSTem:COMMunicate:SERial:PACE XON | NONE

The command sets the software handshake. *RST has no influnence on this parameter.

XON	Software handshake using the ASCII codes 11h (XON) and 13h (XOFF). **Note:** *This mode is not recommended for binary data and for baud rates above 9600 bauds.*
NONE	No software handshake.
Example:	`:SYST:COMM:SER:PACE NONE` *RST value is NONE

:SYSTem:ERRor?

The command queries the entry that has been in the error queue for the longest time. Positive error numbers denote errors specific of the instrument, negative error numbers denote error messages specified by SCPI (see annex B). If the error queue is empty, 0, "No error", is returned. The command is identical to `STATus:QUEue:NEXT?`

Example: `:SYST:ERR?` Response: `-221, "Settings conflict"`

:SYSTem:KLOCk ON | OFF

The command (Keyboard LOCk) disables the keyboard of the SMIQ including the [LOCAL] key or enables it again (OFF).

Caution: *If :SYSTem:SECurity is ON, the keyboard cannot be enabled, i.e., :SYSTem:KLOCk OFF is not accepted. If the disabling of the command is released by switching over to :SYSTem:SECurity OFF, data will be lost.*

Example: `:SYST:KLOC ON` *RST value is OFF

:SYSTem:MODE FIXed | MSEQence

The command sets the operating mode of the instrument.

FIXed	The overall instrument state can only be switched over using *RCL.
MSEQuence	The instrument successively sets the instrument states indicated under `:SYSTem:MSEQuence:RCL`. *RST value is FIXed
Example:	`:SYST:MODE FIX`

:SYSTem:MSEQuence

This node follows the SOURce:LIST system. It can manage several memory sequences which each consist of a list of instrument state numbers and a time list. If `:SYSTem:MODE` is switched to MSEQuence, the instrument states stated in the list selected are set successively for the time stated in the time list in each case.

:SYSTem:MSEQuence:CATalog?

The command queries the memory sequences available. It returns a list, the entries are separated by means of commas.

Example: `:SYST:MSEQ:CAT?` Response: `"SEQ1", "DEMO", "SEQA"`

:SYSTem:MSEQuence:DELete "Name of sequence"

The command deletes the memory sequence indicated.

Example: `:SYST:MSEQ:DEL "SEQ1"`

:SYSTem:MSEQuence:DELete:ALL

The command deletes all memory sequences. The memory-sequence mode must be switched off as a selected sequence cannot be deleted (`SYSTem:MODE FIXed`).

Example: `:SYST:MSEQ:DEL:ALL`

:SYSTem:MSEQuence:DWELl 50 ms to 60 s{,50 ms to 60 s}

For the memory sequence which has currently been selected, the command transmits a list indicating the time for which an instrument setting is "held" in each case before the instrument proceeds to the next setting. If DWELl indicates only one parameter, every item of the instrument state list is set for the same, indicated time. Lists are not influenced by *RST.

Example: `:SYST:MSEQ:DWEL 1s`

:SYSTem:MSEQuence:FREE?

The command queries the space available for memory sequences. It returns two values. The first value indicates the space still vacant, the second the space already occupied.

Example: `:SYST:MSEQ:FREE?` Response: `20, 236`

:SYSTem:MSEQuence:MODE AUTO I STEP

The command indicates in which way the memory sequence is to be processed (by analogy with `:SOURce:SWEep:MODE`) .

AUTO	Each trigger event triggers a complete cycle of the memory sequence selected with automatic restart at the beginning.
STEP	Each trigger event only triggers one step in processing the memory sequence.

Example: `:SYST:MSEQ:MODE AUTO` *RST value is AUTO

:SYSTem:MSEQuence[:RCL] 1 to 50 {,1 to 50}

The command transmits the list of the instrument states to be assumed successively. The list contains integers denoting the states stored by means of *SAV. These instrument states are set successively using a simulated *RCL (thus the name of the list). The length of the list is not limited. The values of the list are between 1 and 50 (number of memory locations to be called). Lists are not influenced by *RST.

Example: `:SYST:MSEQ:RCL 30, 31, 32 ,32 ,32 , 33`

:SYSTem:MSEQuence[:RCL]:POINts?

The command queries the length of the RCL list selected. The RCL list is user-defined and of variable length. The maximal length of the list can be queried by means of `:SYSTem:MSEQence:FREE?` (addition of the two values)..

Example: `:SYST:MSEQ:RCL:POIN?` Response: `17`

:SYSTem:MSEQuence:SELect "Name of sequence"

The command selects a memory sequence. The name of the sequence may be an arbitrary character string of up to 7 letters. If there is no memory sequence of the name indicated, the command creates it, i.e., this command can be used to generate new lists.

Example: `:SYST:MSEQ:SEL "SEQA"`

:SYSTem:PRESet

The command triggers an instrument reset. It has the same effect as the RESET key of the manual control or as command *RST. This command triggers an event and hence has no *RST value.

Example: `:SYST:PRES`

:SYSTem:PROTect1|2|3

The commands to disable certain instrument functions are under this node. A list of the functions concerned can be found in the manual control (Section Password Input With Protected Functions). There are three protection levels which are differentiated by means of a suffix after PROTect. *RST has no effects on the disabling/enabling of the instrument functions.

:SYSTem:PROTect1|2|3 [:STATe] ON | OFF, password

The command switches a protection level on or off. The passwords are 6-digit numbers. They are fixedly stored in the firmware. The password for the first level is 123456.

ON	disables the functions belonging to this protection level. A password need not be indicated.
OFF	deactivates the disabling again if the correct password is indicated. Otherwise an error -224, "Illegal parameter value" is generated and STATe remains ON.

Example: `:SYST:PROT1:STAT  OFF, 123456`

:SYSTem:SECurity

The commands setting the security characteristics of the instrument are under this node.

:SYSTem:SECurity[:STATe] ON | OFF

The command switches the security state on or off. The command is not influenced by *RST and *RCL.

ON The following commands cannot be executed:

```
:DISPlay:ANNotation:ALL ON
:DISPlay:ANNotation:FREQ ON
:DISPlay:ANNotation:AMPLitude ON
:SYSTem:KLOCk OFF
```

OFF In the transition from ON to OFF all data existing in the instrument except for the calibrating data are deleted, especially all status registers, all instrument states and all lists.

Example: `:SYST:SEC:STAT ON`

:SYSTem:SERRor?

This command returns a list of all errors existing at the point of time of the query. This list corresponds to the indication on the ERROR page with manual control (cf. Section Error Messages).

Example: `:SYST:SERR?`
Response: `-221, "Settings conflict", 153, "Input voltage out of range"`

:SYSTem:VERSion?

The command returns the SCPI version number the instrument acts in accordance with. This command is a query and thus has no *RST value.

Example: `:SYST:VERS?` Response: `1994.0`

:SYSTem:SSAVe 1...1000

This command saves the current device setting at the memory location indicated.

:SYSTem:SREStore 1...1000

This command loads a device status that was stored using the `:SYSTem:SSAVe` command (RESTORE). One of 1000 available memory locations is selected by entering a numeral.

! <least significant byte> <most significant byte>

This command has the same effect as the `:SYSTem:SREStore` command. The setting time however is 300 µs less. It is optimized for highest speed and does not comply with the SCPI syntax regulations. Exactly 3 bytes are transmitted including the `'!'` (which is the identifier of this command). With the last byte, EOI has to be activated as delimiter.
The memory location is binary-coded in the 2 bytes indicated.

3.5.15 TEST-System

This system contains the commands to execute the selftest routines (`FSIM?`, `RAM?`, `ROM?` and `BATTery?`) as well as to directly manipulate the hardware modules (`:TEST:DIRect`). The selftests return a "0" if the test has been executed successfully, otherwise a value unequal to "0". All commands of this system do not have an *RST value.

Caution: *The commands under node* `:TEST:DIRect` *directly act on the respective hardware module circumventing any security mechanisms. They are provided for service purposes and should not be used by the user. Improper use of the commands may damage the module.*

Command	Parameter	Default Unit	Remark
:TEST			
:DIRect			
:ATTC	Subaddress, hex data string		
:DGEN	Subaddress, hex data string		
:DSYN0MUX	Subaddress, hex data string		
:DSYN1MUX	Subaddress, hex data string		
:FMOD	Subaddress, hex data string		
:FSIM1M	Subaddress, hex data string		
:FSIM2M	Subaddress, hex data string		
:IQCON	Subaddress, hex data string		
:IQMOD	Subaddress, hex data string		
:MCOD	Subaddress, hex data string		
:REFSS	Subaddress, hex data string		
:NDSim	Subaddress, hex data string		
:ROSC	Subaddress, hex data string		
:SUM	Subaddress, hex data string		
:FSIM?			Query only
:RAM?			Query only
:ROM?			Query only
:BATTery			
[:RAM]?			Query only
:DGEN?			Query only

:TEST:DIRect

This node contains the commands directly acting on the respective hardware module circumventing any security mechanisms. The commands under this node have no short form.

:TEST:DIRect:ATTC Subaddress, hex data string

The command directly acts on module ATTC. A subaddress (0 or 1) must be indicated as a parameter. The data are indicated as a <string> (i.e., an ASCII character string enclosed in quotation marks) representing hexadecimal numbers. Thus characters 0 to 9 A to F may occur in the character string.

Example: `:TEST:DIR:ATTC 0, "0010AF1F"`

Query: `:TEST:DIR:ATTC? 0`

:TEST:DIRect:DGEN Subaddress, hex data string

The command acts on module DGEN (cf. `:TEST:DIR:ATTC`).

:TEST:DIRect:DSYN0MUX Subaddress, hex data string

The command acts on module DSYN. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:DSYN1MUX Subaddress, hex data string

The command acts on module DSYN. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:FMOD Subaddress, hex data string

The command acts on module FMOD. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:FSIM1M Subaddress, hex data string

The command acts on module FSIM1M. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:FSIM2M Subaddress, hex data string

The command acts on module FSIM2M. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:IQCON Subaddress, hex data string

The command acts on module IQCON. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:IQMOD Subaddress, hex data string

The command acts on module IQMOD. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:MCOD Subaddress, hex data string

The command acts on module MCOD. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:NDSim Subaddress, hex data string

The command acts on module NDSIM. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:REFSS Subaddress, hex data string

The command acts on module REFSS. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:ROSC Subaddress, hex data string

The command acts on module ROSC. (cf. `:TEST:DIR:ATTC`)

:TEST:DIRect:SUM Sub address, hex data string

The command acts on module SUM. (cf. `:TEST:DIR:ATTC`)

:TEST:FSIM?

The command triggers a test of the Fading Simulator.

:TEST:RAM?

The command triggers a test of the RAM.

:TEST:ROM?

The command triggers a test of the EPROM.

:TEST:BATTery[:RAM]?

The command triggers a test of the RAM battery voltage. The voltage should be at least 2.5 V.

:TEST:BATTery:DGEN?

The command triggers a test of the battery voltage of the data generator.

3.5.16 TRIGger-System

The TRIGger system contains the commands to select the trigger source and to configure the external trigger socket. The suffix is only important for the SWEEP subsystem:
TRIGger1 = RF generator
TRIGger2 = LFGEN

The trigger system of the SMIQ is a simplified implementation of the SCPI trigger system. Compared to SCPI, the TRIGger system shows the following differences:

- No INITiate command, the instrument behaves as if `INITiate:CONTinuous ON` was set.
- There are several subsystems denoting the different parts of the instrument under TRIGger (SWEep, LIST, MSEQuence).

Further commands as to the trigger system of the SMIQ can be found in the ABORt system.

Command	Parameter	Default Unit	Remark
:TRIGger1|2			
[:SWEep]			
[:IMMediate]			no query
:SOURce	SINGle | EXTernal | AUTO		
:LIST			
[:IMMediate]			no query
:SOURce	SINGle | EXTernal | AUTO | HOP		
:DM			
[:IMMediate]			no query
:SOURce	SINGle | EXTernal | AUTO		
:MSEQuence			
[:IMMediate]			no query
:SOURce	SINGle | EXTernal | AUTO		
:SLOPe	POSitive | NEGative		

:TRIGger1|2[:SWEep]

All commands to trigger a sweep are under this node. The settings here act on level and frequency sweeps for RF generator (TRIG1) and LF generator (TRIG2).

:TRIGger1|2[:SWEep][:IMMediate]

The command immediately starts a sweep. Which sweep is executed depends on the respective MODE setting, e.g. `:SOURce:FREQuency:MODE SWEep`. The command corresponds to manual-control command EXECUTE SINGLE SWEEP. This command triggers an event and thus has no *RST value.

Example: `:TRIG:SWE:IMM`

:TRIGger1|2[:SWEep]:SOURce AUTO | SINGle | EXTernal

The command specifies the trigger source. The naming of the parameters directly corresponds to the different settings with manual control. SCPI uses other designations for the parameters the instrument accepts as well. These designations are to be preferred if compatibility is important. The following table provides an overview.

SMIQ designation	SCPI designation	Command with manual control
AUTO	IMMediate	MODE AUTO
SINGle	BUS	MODE SINGLE or STEP
EXTernal	EXTernal	MODE EXT TRIG SINGLE or EXT TRIG STEP

AUTO	The trigger is free-running, i.e., the trigger requirement is permanently met. As soon as a sweep has been terminated, the next one is started.
SINGle	Triggering is effected by means of IEC-bus commands `:TRIGger:SWEep:IMMediate` or `*TRG`. If `:SOURce:SWEep:MODE` is set to `STEP`, a step, in the case of the `AUTO` setting a complete sweep, is executed.
EXTernal	Triggering is effected from outside via the EXT.TRIG. socket or by the GET command via IEC/IEEE-bus (see annex A). The action triggered depends on the setting of the sweep mode as in the case of SINGle.
Example:	`:TRIG:SWE:SOUR AUTO` *RST value is SINGle

:TRIGger:LIST

This node contains all commands to trigger a list in the LIST mode.

:TRIGger:LIST[:IMMediate]

The command immediately starts the processing of a list of the LIST mode. It corresponds to command EXECUTE SINGLE MODE of the manual control in the LIST menu. This command is an event and thus has no *RST value.

Example: `:TRIG:LIST:IMM`

:TRIGger1|2:LIST:SOURce AUTO | SINGle | EXTernal | HOP

The command specifies the trigger source. The naming of the parameters corresponds to the one with sweep mode. SCPI uses other designations for the parameters the instrument accepts as well. These designations are to be preferred if compatibility is important. The following table provides an overview:

SMIQ designation	SCPI designation	Command with manual control
AUTO	IMMediate	MODE AUTO
SINGle	BUS	MODE SINGLE or STEP
EXTernal	EXTernal	MODE EXT TRIG SINGLE or EXT TRIG STEP
HOP	-----	MODE HOP

AUTO	The trigger is free-running, i.e., the trigger condition is permanently fulfilled. As soon as the list selected has been finished in the LIST mode, it is started anew.
SINGle	Triggering is executed by means of IEC-bus command :TRIGger:LIST :IMM. The list is executed once.
EXTernal	Triggering is carried out from outside via the EXT.TRIG. socket or by the GET command via IEC/IEEE-bus (see annex A). The list is executed once
HOP	Triggering is carried out from inside via control list (HOP bit is set; option SMIQB11 data generator). Only with `LIST:MODE STEP`.

Example: `:TRIG:LIST:SOUR AUTO` *RST value is SINGle

:TRIGger:DM

The commands for the autorun control of digital modulation are under this node. These commands are only valid for TRIGger1.

:TRIGger:DM[:IMMediate]

In case of basic digital modulations, this command immediately starts the processing of the data list of the DM data generator. The command acts on the type of modulation presently set using `:SOURce:DM:TYPE`. It corresponds to the EXECUTE SINGLE command of the manual control in the associated DIGITAL MOD menu. This command is an event and thus has no *RST value.

Example: `:TRIG:DM:IMM`

:TRIGger:DM:SOURce AUTO | SINGle | EXTernal

The command specifies the valid trigger events. See following table for effect on complex modulation.

AUTO	The trigger condition is always fulfilled. In case of basic digital modulations, the list is processed repeatedly, the RF signal is continuously DM-modulated.
SINGle	The trigger condition can be fulfilled by manual control or by using the commands `TRIG:DM:IMM` oder `*TRG`. The list is processed only once. DM is subsequently inactive.
EXTernal	This setting has no effect on the basic digital modulations.

Example: `:TRIG:DM:SOUR AUTO` *RST value is AUTO

:TRIGger:MSEQuence

This node contains all commands to trigger a memory sequence. The commands are only valid for TRIGger1.

:TRIGger:MSEQuence[:IMMediate]

The command immediately starts a memory sequence. It corresponds to the EXECUTE SINGLE MODE command of the manual control in the MEMORY SEQUENCE menu. This command is an event and thus has no *RST value.

Example: `:TRIG:MSEQ:IMM`

:TRIGger:MSEQuence:SOURce AUTO | SINGle | EXTernal

The command specifies the trigger source (cf. `:TRIGger:SWEep:SOURce`)

Example: `:TRIG:MSEQ:SOUR AUTO` *RST value is SINGle

:TRIGger:SLOPe POSitive | NEGative

The command indicates whether the external trigger input only responds to the positive, the negative or to both edges of the trigger signal. The command acts on `TRIGger:SWEep`, `TRIGger:LIST` and `TRIGger:MSEQuence`. The pulse generator has an own trigger input and thus also an own SLOPe command. *RST value is POSitiv

Example: `:TRIG:SLOP NEG`

3.5.17 UNIT-System

This system contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

Command	Parameter	Default Unit	Remark
:UNIT			
:ANGLe	DEGReel DEGree I RADian		
:POWer	DBM I DBW I DBMW I DBUW I DBV I DBMV I DBUV I V		

:UNIT:ANGLe DEGRee I DEGree I RADian

The command indicates the unit for angles. *RST value is RADian

Example: `:UNIT:ANGL DEGR`

:UNIT:POWer DBM I DBW I DBMW I DBUW I DBV I DBMV I DBUV I V

The command indicates the unit for power. *RST value is DBM

Example: `:UNIT:POW V`

3.6 Instrument Model and Command Processing

The instrument model shown in Fig. 3-2 has been made viewed from the standpoint of the servicing of IEC-bus commands. The individual components work independently of each other and simultaneously. They communicate by means of so-called "messages".

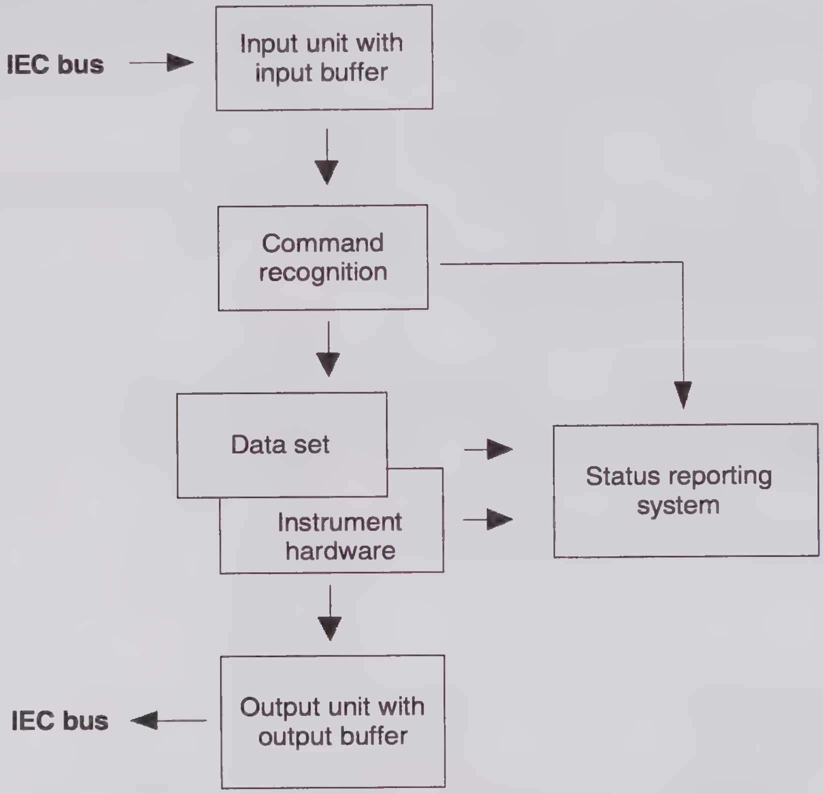


Fig. 3-2 Instrument model in the case of remote control by means of the IEC bus

3.6.1 Input Unit

The input unit receives commands character by character from the IEC bus and collects them in the input buffer. The input buffer has a size of 1024 characters. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.

If the input buffer is full, the IEC-bus traffic is stopped and the data received up to then are processed. Subsequently the IEC-bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

3.6.2 Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before as well. Each recognized command is immediately transferred to the data set but without being executed there at once.
Syntactical errors in the command are recognized here and supplied to the status reporting system. The rest of a command line after a syntax error is analyzed further if possible and serviced.
If the command recognition recognizes a delimiter or a DCL, it requests the data set to set the commands in the instrument hardware as well now. Subsequently it is immediately prepared to process commands again. This means for the command servicing that further commands can already be serviced while the hardware is still being set ("overlapping execution").

3.6.3 Data Set and Instrument Hardware

Here the expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included.

The data set is a detailed reproduction of the instrument hardware in the software.

IEC-bus setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. As this is always only effected at the end of a command line, the order of the setting commands in the command line is not relevant.

The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that an execution is not possible, an "execution error" is signaled to the status reporting system. All alterations of the data set are canceled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, it is permissible to set impermissible instrument states within one command line for a short period of time without this leading to an error message (example: simultaneous activation of FM and PM). At the end of the command line, however, a permissible instrument state must have been reached again.

Before passing on the data to the hardware, the settling bit in the STATus:OPERation register is set. The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

IEC-bus queries induce the data set management to send the desired data to the output unit.

3.6.4 Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in the next section.

3.6.5 Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer. The output buffer has a size of 1024 characters. If the information requested is longer, it is made available "in portions" without this being recognized by the controller.
If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC bus, the controller waits until it has reached its time limit. This behavior is specified by SCPI.

3.6.6 Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping. Equally, setting commands within one command line are not absolutely serviced in the order in which they have been received.

In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line, that is to say, with a separate IBWRT()-call.
In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By a suitable programming, the controller can be forced to wait for the respective action to occur (cf. Table 3-3).

Table 3-3 Synchronization with *OPC, *OPC? and *WAI

Command	Action after the hardware has settled	Programming the controller
*OPC	Setting the operation-complete bit in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	The next command is executed only after having processed all of the preceeding commands.	Sending the next command

An example as to command synchronization can be found in annex D "Program Examples".

3.7 Status Reporting System

The status reporting system (cf. Fig. 3-4) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out an AUTORANGE and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 3-4.

3.7.1 Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 3-3). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

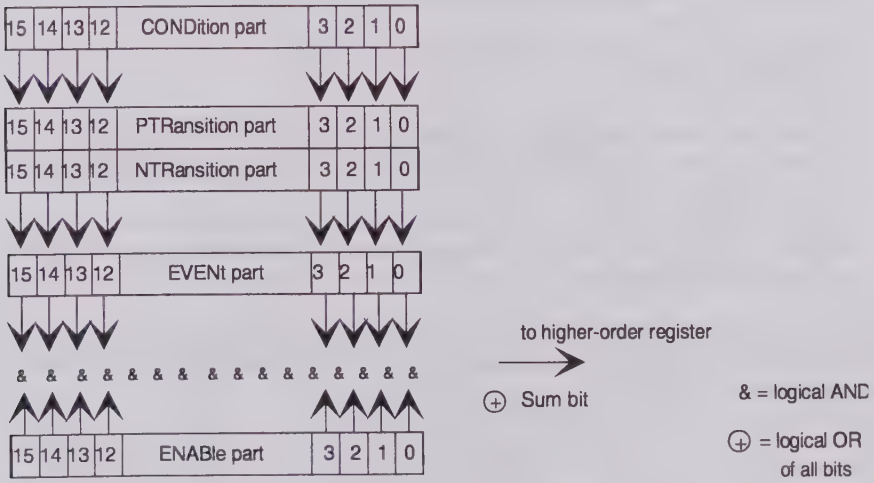

15 14 13 12 CONDition part 3 2 1 0
15 14 13 12 PTRansition part 3 2 1 0
15 14 13 12 NTRansition part 3 2 1 0
15 14 13 12 EVENt part 3 2 1 0
& & & & & & & & & & & & & & & &
15 14 13 12 ENABle part 3 2 1 0
to higher-order register
⊕ Sum bit
& = logical AND
⊕ = logical OR of all bits

Fig. 3-3 The status -register model

CONDition part	The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.
PTRansition part	The Positive-TRansition part acts as an edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1. PTR bit =1: the EVENt bit is set. PTR bit =0: the EVENt bit is not set. This part can be written into and read at will. Its contents is not affected by reading.
NTRansition part	The Negative-TRansition part also acts as an edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1. NTR bit =1: the EVENt bit is set. NTR bit =0: the EVENt bit is not set. This part can be written into and read at will. Its contents is not affected by reading. With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.
EVENt part	The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. During reading, its contents is set to zero. In linguistic usage this part is often equated with the entire register.
ENABle part	The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+'). ENAB bit =0: the associated EVENt bit does not contribute to the sum bit ENAB bit =1: if the associated EVENT bit is "1", the sum bit is set to "1" as well. This part can be written into and read by the user at will. Its contents is not affected by reading.
Sum bit	As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register. The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note: *The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.*

3.7.2 Overview of the Status Registers

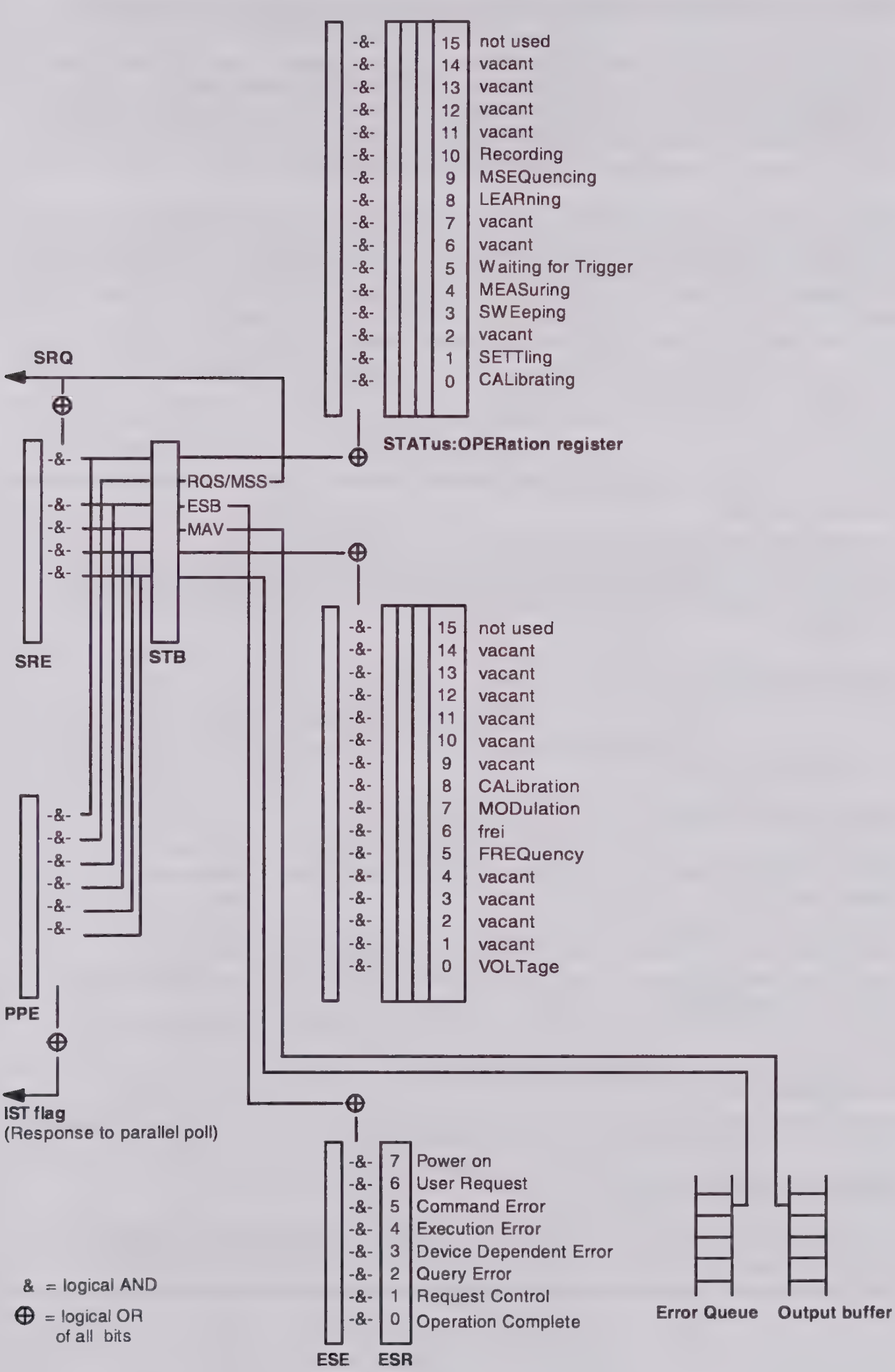


Fig. 3-4 Overview of the status register

3.7.3 Description of the Status Registers

3.7.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.
The STATUS BYTE is read out using the command "*STB?" or a serial poll.

The STB implies the SRE. It corresponds to the ENABle part of the SCPI registers as to its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the IEC bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command "*SRE" and read using "*SRE?".

Table 3-4 Meaning of the bits used in the status byte

Bit no.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with IEC-bus control.
3	**QUEStionable status sum bit** The bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable status register.
4	**MAV-Bit** (Message AVailable) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. annex D, program examples).
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit implies a serious error which can be specified in greater detail by polling the event status register.
6	**MSS-Bit** (Master Status Summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by polling the OPERation status register.

3.7.3.2 IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll or using command "`*IST?`".

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The Ist flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "`*PRE?`".

3.7.3.3 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is already defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "`*ESR?`".
The ESE is the associated ENABle part. It can be set using command "`*ESE`" and read using command "`*ESE?`".

Table 3-5 Meaning of the bits used in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct, however, cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
6	**User Request** This bit is set on pressing the LOCAL key, i.e., when the instrument is switched over to manual control.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

3.7.3.4 STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands `"STATus:OPERation:CONDition?"` or `"STATus:OPERation[:EVENt]?"`..

Table 3-6 Meaning of the bits used in the STATus:OPERation register

Bit-No.	Meaning
0	**CALibrating** This bit is set as long as the instrument is performing a calibration.
1	**SETTling** This bit is set as long as the new status is settling after a setting command. It is only set if the settling time is longer than the command processing time.
3	**SWEeping** This bit is set while the instrument is performing a sweep.
4	**MEASuring** This bit is set while the instrument is performing a measurement.
5	**WAIT for TRIGGER** This bit is set as long as the instrument is waiting for a trigger event.
8	**LEARning** This bit is set while the instrument is "learning" a list.
9	**MSEQuencing** This bit is set while the instrument is performing a memory sequence.
10	**RECording** This bit is set while the instrument is recording external data via the DATA input.

3.7.3.5 STATus:QUEStionable Register

This register contains information on questionable instrument states. They can occur, e.g. if the instrument is operated out of its specifications. It can be queried using commands `"STATus:QUEStionable:CONDition?"` or `"STATus:QUEStionable[:EVENt]?"`.

Table 3-7 Meaning of the bits used in the STATus:QUEStionable register

Bit-No.	Meaning
0	**VOLTage** This bit is set if the voltage at an output connector is not correct, if the voltage is above or below the specified limit values, if the level limit has responded, if the overvoltage protection has responded.
5	**FREQuency** The bit is set if a frequency at the RF output is not correct or if it is lower or higher than the specified values
7	**MODulation** The bit is set if a modulation is not correct or is operated outside the specifications.
8	**CALibration** The bit is set if a calibration is not performed properly.

3.7.4 Application of the Status Reporting Systems

In order to be able to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are represented in the following. Detailed program examples are to be found in annex D, Programming Examples.

3.7.4.1 Service Request, Making Use of the Hierarchy Structure

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react with corresponding actions. As evident from Fig. 3-4, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The corresponding setting of the ENABle parts of the status registers can achieve that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request, all bits should be set to "1" in enable registers SRE and ESE.

Examples (cf. Fig. 3-4 and Program Examples, annex D as well):

Use of command "`*OPC`" to generate an SRQ

- Set bit 0 in the ESE (Operation Complete)
- Set bit 5 in the SRE (ESB)

  After its settings have been completed, the instrument generates an SRQ.

Indication of the end of a sweep by means of an SRQ with the controller

- Set bit 7 in the SRE (sum bit of the STATus:OPERation register)
- Set bit 3 (sweeping)in the STATus:OPERation:ENABle.
- Set bit 3 in the STATus:OPERation:NTRansition so as to make sure that the transition of sweeping bit 3 from 1 to 0 (sweep end) is recorded in the EVENt part.

  After a sweep has been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request. A detailed example for a service request routine is to be found in annex D , Program Examples.

3.7.4.2 Serial Poll

In a serial poll, just as with command "`*STB`", the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works with instruments which do not adhere to SCPI or IEEE 488.2.

The quick-BASIC command for executing a serial poll is "`IBRSP()`". Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the IEC bus.

3.7.4.3 Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller by means of a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to logically "0" or "1". By analogy to the SRE register which determines under which conditions an SRQ is generated, there is a parallel poll enable register (PPE) which is ANDed with the STB bit by bit as well considering bit 6. The results are ORed, the result is then sent (possibly inverted) as a response in the parallel poll of the controller. The result can also be queried without parallel poll by means of command "`*IST`".

The instrument first has to be set for the parallel poll using quick-BASIC command "`IBPPC()`". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "`IBRPP()`".

The parallel-poll method is mainly used in order to quickly find out after an SRQ which instrument has sent the service request if there are many instruments connected to the IEC bus. To this effect, SRE and PPE must be set to the same value. A detailed example as to the parallel poll is to be found in annex D, Program Examples.

3.7.4.4 Query by Means of Commands

Each part of every status register can be read by means of queries. The individual commands areindicated in the detailed description of the registers. What is returned is always a number which represents the bit pattern of the register queried. Evaluating this number is effected by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

3.7.4.5 Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be looked at in the ERROR menu via manual control or queried via the IEC bus using command `"SYSTem:ERRor?"`. Each call of `"SYSTem:ERRor?"` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error"

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

3.7.5 Resetting Values of the Status Reporting Systems

Table 3-8 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for `*RST` and `SYSTem:PRESet` influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 3-8 Resetting instrument functions

Event	**Switching on supply voltage**		**DCL,SDC (Device Clear, Selected Device Clear)**	***RST or SYSTem:PRESet**	**STATus:PRESet**	***CLS**
	Power-On-Status-Clear					
Effect	**0**	**1**				
Clear STB,ESR	—	yes	—	—	—	yes
Clear SRE,ESE	—	yes	—	—	—	—
Clear PPE	—	yes	—	—	—	—
Clear EVENt parts of the registers	—	yes	—	—	—	yes
Clear ENABle parts of all OPERation-and QUESTionable registers, Fill ENABle parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with "1" Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e. immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

3.8 Fast Restore Mode

Device settings can be saved and recalled very quickly via the IEC/IEEE bus using the commands described below. 1000 memory locations are available.

In contrast to the SAVE/RECALL function, not the unit parameters but only the setting data of the modules are stored in the Fast Restore mode. RESTORE by means of the `':SYSTem:SREStore'` or `'!..'` command has an immediate effect on the module. The database (which stores all entries and delivers the display data) is bypassed. This allows a very high setup speed.

3.8.1 Commands

:SYSTem:SSAVe 1...1000

This command saves the current device setting at the memory location indicated.

:SYSTem:SREStore 1...1000

This command loads a device status that was stored using the `:SYSTem:SSAVe` command (RESTORE). One of 1000 available memory locations is selected by entering a numeral.

! <least significant byte> <most significant byte>

This command has the same effect as the `:SYSTem:SREStore` command. The setting time however is 300 µs less. It is optimized for highest speed and does not comply with the SCPI syntax regulations. Exactly 3 bytes are transmitted including the `'!'` (which is the identifier of this command). With the last byte, EOI has to be activated as delimiter.
The memory location is binary-coded in the 2 bytes indicated.

Example:

RESTORE at memory location 268 (-> 010C hex) corresponds to the following binary command:

0010 0001	0000 1100	0000 0001
'!'	hex 0C	hex 01

Binary-coded bytes can usually not be written as printable ASCII characters.

When programmed in C, the above command has the following form:

```
char sendstring[3] = {'!', 0x0C, 0x01}
```

In BASIC, the command string to be output is as follows:

```
'!' + CHR$(12) + CHR$(1)
```

(The pros for CHR$ are decimal numbers, therefore 12 for 0C hex.)

Since binary-coded bytes may also have the value of the LF (line feed) character which is interpreted as a delimiter, switch over to 'only EOI' as delimiter by selecting '`:SYSTem:COMMunicate:GPIB:LTERminator EOI`' prior to using this command.

3.8.2 Call-up and termination of operating mode

After a RESTORE, the database does no longer reflect the device setting which means that
- the displayed values are no longer relevant,
- the desired result is not obtained by a query of setup values.
- normal setting commands may not be executed properly (see below 'Alternative ...)

It is therefore recommended either
to use the *RST command or
to store the device setting prior to using the first RESTORE command by means of the :SYSTem:SSAVe n command and to restore it after the last RESTORE command using :SYSTEM:SRESTore n. The database and the device setting will then match again.
No other commands are required to activate or deactivate this mode.

Note: *- Since the module setting depends on the temperature of the unit, any temperature variation of more than 5°C should be avoided between storage and call-up to ensure the accuracy of the unit.*

- If the mechanically switched attenuator is switched over due to a RESTORE command, the setting time increases by 15 ms. This can be avoided by setting one of the two functions for interruption-free level setting (`:OUTPut:AMODe FIXed` or `ELECtronic`) prior to storing the setting.

3.8.3 Effects on device settings:

The Fast Restore commands have an effect on almost all device settings (see table).

Device settings stored and called up by Fast Restore:	Device settings not stored or called up by Fast Restore:
• Frequency incl. reference oscillator	• Settings of baseband signal of digital modulation and digital standard
• Level - incl. mech. switched attenuator, - incl. user correction, - incl. ALC modes	• Functions not regarding the RF output signal, eg commands under `:SYSTem:...` (except for `SYSTem:PRESet`) or `:UNIT:...`
• Analog modulation	• Sweep
• Vector modulation	• List mode
• Switch-on/off of digital modulation	• Memory sequence
• LF generator and LF output	

3.8.4 Alternative use with other IEC/IEEE-bus commands

The alternative use of the RESTORE commands (`':SYSTem:SREStore'` or `'!..'`) and normal IEC/IEEE-bus commands is

- useful in case of digital modulation:
  First, the baseband signal is configured by means of normal commands and digital modulation is switched on. Then, digital modulation can be switched on/off by means of the RESTORE commands.
- possible for all commands that do not regard the RF output signal (eg `:SYSTem:...`, `:UNIT:...`),
- normally not possible for all the functions listed in the left column of the above table. In case of doubt, we recommend testing.

3.8.5 Synchronization signal

In the Fast Restore mode a synchronization signal is available at the rear-panel BLANK connector to synchronize other devices.
The BLANK signal is high during settling of the RF output signal and low in the settled state.

4 Maintenance and Troubleshooting

The instrument does not need a periodic maintenance. What is necessary is essentially the cleaning of the instrument. However, it is recommended to check the rated data from time to time.

4.1 Maintenance

4.1.1 Cleaning the Outside

The outside of the instrument is suitably cleaned using a soft, line-free dustcloth.

Caution! *Do not use solvents such as thinners, acetone and similar things in any case, because otherwise the front panel labeling or plastic parts will be damaged.*

4.1.2 Storage

The storage temperature range of the instrument is -40 to +70 degrees Celsius. If the instrument is to be stored for a longer period of time, it must be protected against dust.

4.2 Functional Test

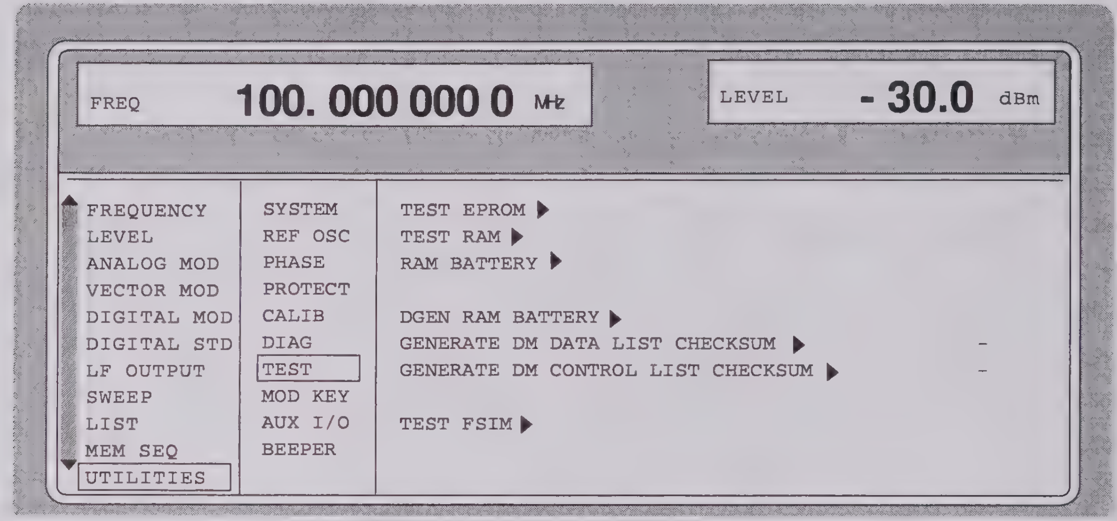
The SMIQ carries out a selftest on switching on the instrument and permanently during operation. On switching on, the RAM and ROM contents are checked and the batteries of the non-volatile RAMs are tested. If an error is detected, this is indicated through a corresponding error message. The most important instrument functions are automatically monitored during operation.

If a faulty function is detected in the selftest, ERROR is displayed in the status line. To identify the error, the ERROR menu, in which the error messages are entered, can be called by pressing the [ERROR] key (cf. Chapter 2, Section "Error Messages").

The tests can additionally be called via the menu.

Access to the tests is offered by the UTILITIES - TEST menu.

Menu selection: UTILITIES - TEST


FREQ 100. 000 000 0 MHz

LEVEL - 30.0 dBm

Fig. 4-1 UTILITIES-TEST menu

TEST EPROM ▶	Tests the EPROM. The test result is displayed in a window. IEC/IEEE-bus-command `:TEST:BATT:ROM?`
TEST RAM ▶	Tests the RAM. The test result is displayed in a window. IEC/IEEE-bus-command `:TEST:BATT:RAM?`
RAM BATTERY ▶	Tests the RAM battery. The test result is displayed in a window. IEC/IEEE-bus-command `:TEST:BATT?`
DGEN RAM BATTERY ▶	Tests the RAM battery of the data generator. The test result is displayed in a window. IEC/IEEE-bus-command `:TEST:BATT:DGEN?`
GENERATE DM DATA LIST CHECKSUM ▶	Calculates the checksum of the active data list. The following algorithm is applied: The entries in the list are interpreted as binary numbers with a length of 32 bits. The most significant bit is on the left side. All 32-bit numbers are added modulo 2^{32}. The result is displayed in hexadecimal representation. IEC/IEEE-bus-command `:DIAG:DLIS:CHEC` `:DIAG:DLIS:DATA?`
GENERATE DM CONTROL LIST CHECKSUM ▶	Calculates the checksum of the active control list. (algorithm see above). IEC/IEEE-bus-command `:DIAG:CLIS:CHEC` `:DIAG:CLIS:DATA?`
TEST FSIM ▶	Tests the Fading Simulator. The test result is displayed in a window. IEC/IEEE-bus-command `:TEST:FSIM?`

5 Checking the Rated Characteristics

5.1 Test Equipment and Test Assemblies

5.1.1 Measuring Equipment and Accessories

Table 5-1 Measuring equipment and accessories

Item	Type of Instrument	Required Characteristics	Suitable Instrument	R&S Order No.
1	Frequency counter (included in item 2)	1 Hz to RF_{max}, resolution 0.1 Hz		
2	RF spectrum analyzer	100 Hz to 26 GHz, synthesizer tuning, dynamic range >80 dB	FSIQ26	1119.6001.26
3	Storage oscilloscope	100 Msamples/s, averaging function		
4	Controller	Industry standard PC/XT/AT with IEC-625 interface	PSM17	1116.5004.70
5	Signal generator of high spectral purity	0.1 MHz to RF_{max}, SSB noise level <-126 dBc at 1 GHz/20 kHz	SMIQ02B to 06B	1125.5555.02 to 06
6	Phase noise test assembly	Mixer: 10 MHz to RF_{max}, branching filter 2 MHz, preamplifier with gain of approx. 30 dB, input noise < 2 nV (1 Hz), DC decoupling after mixer for oscilloscope		
7	Oscilloscope (usually included in item 3)	Bandwidth > 100 MHz, two channels with DC coupling		
8	RF power meter	5 kHz to RF_{max}	NRVS with NRV-Z51	1020.1809.02 0857.9004.02
9	Precision attenuator	Attenuation 0 to 120 dB, resolution 5 dB	RSG	1009.4505.02
10	Low-noise preamplifier	5 kHz to RF_{max}, gain > 20 dB, noise figure < 10 dB		
11	VSWR bridge	40 kHz to 4 GHz directivity > 40 dB	ZRC	1039.9492.55/52
12	DC voltage source	Setting range 0 to 10 V	NGMD35	0117.7127.02
13	RF power amplifier	10 MHz to RF_{max}, power > 1 W		
14	Audio analyzer	Generator up to 100 kHz, level meter, distortion meter	UPD UPL06	1030.7500.05 1078.2008.06
15	Modulation analyzer	100 kHz to RF_{max}, AM, FM, φM, stereo coder, stereo decoder, distortion meter, weighting filter ITU-R, ITU-T	FMB with FMA-B1, FMA-B2, FMA-B3, FMA-B4	856.5005.52
16	Mixer	10 MHz to RF_{max}, high level		
17	Pulse generator	Pulse repetition frequency up to 10 MHz, TTL level	AFG	377.2100.02

Item	Type of Instrument	Required Characteristics	Suitable Instrument	R&S Order No.
18	Sinewave generator	10 Hz to 8 MHz, 1 V (V_{peak})	AMS, ADS, AFG	1013.0000.02, 1013.1494.02, 377.2100.02
19	AC/DC voltmeter	10 Hz to 8 MHz	URE3	350.5315.03
20	Broadband FM demodulator	Delay line discriminator, input frequency 50 MHz, electrical line length 15 m, demodulation bandwidth 10 MHz		
21	RF attenuator	DC to RF_{max}, 3 dB	DNF	0272.4010.50
22	Lowpass filter	Attenuation up to 50 MHz < 1 dB at 100 MHz > 20 dB at 200 MHz > 40 dB		
23	Demodulator for digital modulations	Error vector measurement	Included in item 2, option K11 (for GSM)	1057.3392.02
24	Arbitrary waveform generator	Two channels	AMIQ	1110.2003.02
25	Program for simulation of digital modulations	Generation of data for ARB generator	WinIQSIM, included in item 24	
26	Directional coupler	High directivity, 3.3 GHz to RF_{max}	Narda MODEL 3292-1	

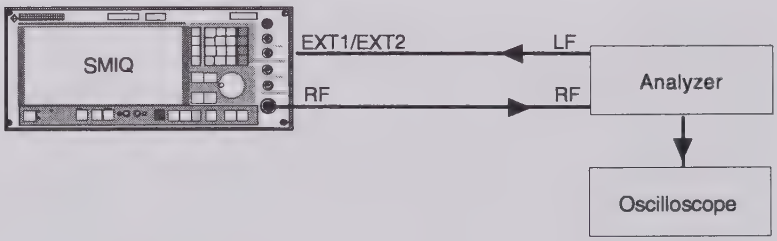
5.1.2 Test Assemblies

5.1.2.1 Standard Test Assembly for Analog Modulations

Test equipment

- Modulation analyzer (Table 5-1, item 15)
- Oscilloscope (Table 5-1, item 7, only for a few measurements)

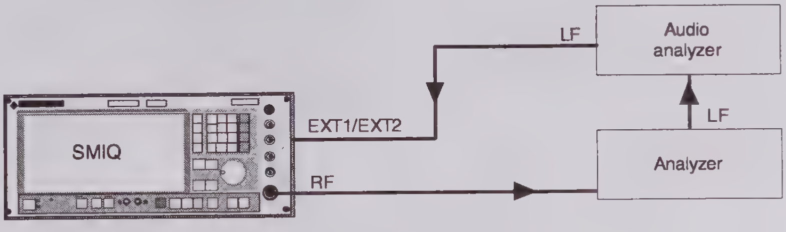
Test setup



5.1.2.2 Test Assembly for Analog Modulations with Audio Analyzer

Test equipment
- Modulation analyzer (Table 5-1, item 15)
- Audio analyzer (Table 5-1, item 14)

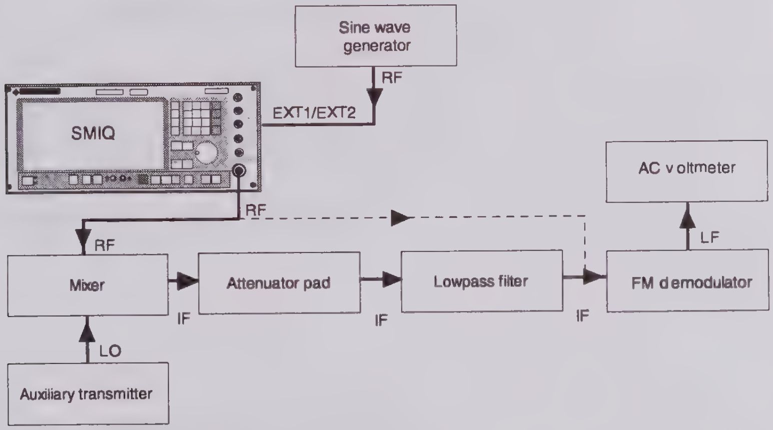
Test setup



5.1.2.3 Test Assembly for Broadband FM

Test equipment
- Second signal generator (Table 5-1, item 5)
- Mixer (Table 5-1, item 16)
- Sinewave generator (Table 5-1, item 18)
- AC voltmeter (Table 5-1, item 19)
- Broadband FM demodulator (Table 5-1, item 20)
- RF attenuator (Table 5-1, item 21)
- Lowpass filter (Table 5-1, item 22)

Test setup

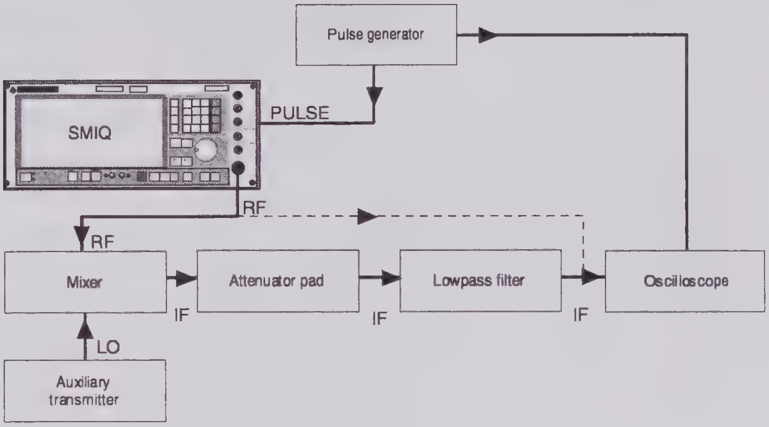


5.1.2.4 Test Assembly for Pulse Modulation

Test equipment

- Second signal generator (Table 5-1, item 5)
- Oscilloscope (Table 5-1, item 7)
- Mixer (Table 5-1, item 16)
- Pulse generator (Table 5-1, item 17)
- RF attenuator (Table 5-1, item 21)
- Lowpass filter (Table 5-1, item 22)

Test setup

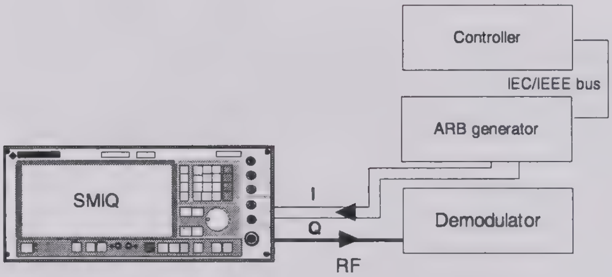


5.1.2.5 Test Assembly for Vector Modulation

Test equipment

- Demodulator for digital modulation (Table 5-1, item 23)
- Arbitrary waveform generator (Table 5-1, item 24)
- Program for simulation of digital modulations (Table 5-1, item 25)
- Controller to industry standard (Table 5-1, item 4)

Test setup

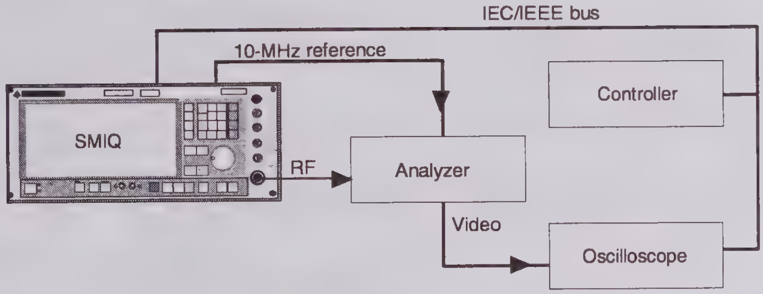


5.1.2.6 Test Assembly for Settling Time

Test equipment

- Spectrum analyzer with video output (Table 5-1, item 2)
- Storage oscilloscope (Table 5-1, item 3)
- Controller (Table 5-1, item 4)

Test setup

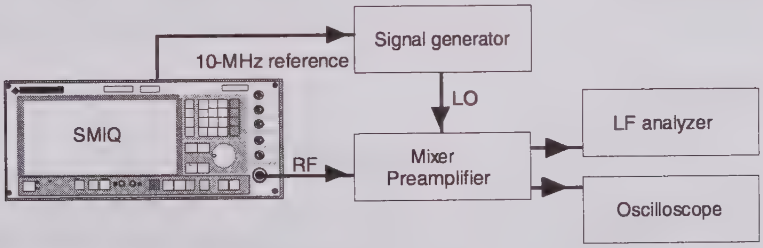


5.1.2.7 Test Assembly for SSB Phase Noise

Test equipment

- Second signal generator (Table 5-1 item 5),
- Phase noise test assembly consisting of mixer with lowpass filter and preamplifier (Table 5-1 item 6)
- Oscilloscope (Table 5-1 item 7)
- Spectrum analyzer (Table 5-1 item 2)

Test setup

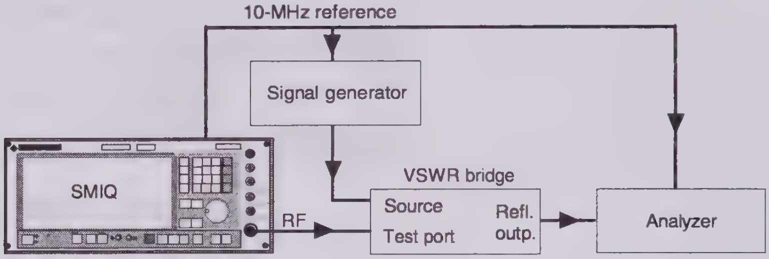


5.1.2.8 Test Assembly for Output Impedance (VSWR)

Test equipment

- VSWR bridge (Table 5-1, item 11), for frequencies >3.3 GHz directional coupler (Table 5-2, item 26)
- Second signal generator (Table 5-1, item 5)
- Spectrum analyzer (Table 5-1, item 2)

Test setup



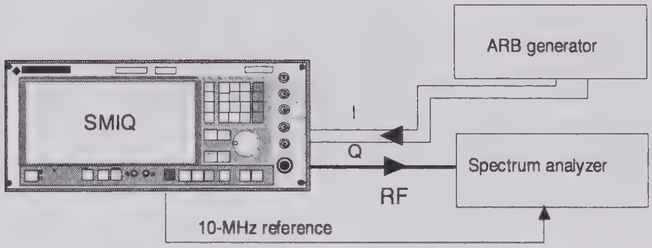
Note: *The test port of the VSWR bridge has to be screwed directly to the DUT. The INPUT connector of the directional coupler, too, has to be screwed directly to the DUT. The line output of the directional coupler has to be connected to the second signal generator, and the reflection output (-13 dB) to the analyzer.*

5.1.2.9 Test Assembly with Spectrum Analyzer for Fading Simulation

Test equipment

- Arbitrary waveform generator (Table 5-1, item 24)
- Spectrum analyzer (Table 5-1, item 2)

Test setup

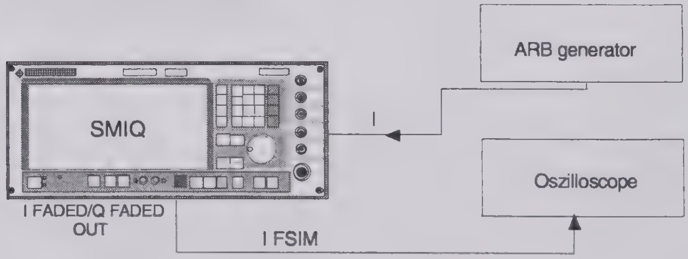


5.1.2.10 Test Assembly with Sampling Oscilloscope for Fading Simulation

Test equipment

- Arbitrary waveform generator (Table 5-1, item 24)
- Sampling oscilloscope (Table 5-1, item 3)

Test setup



5.2 Preparation, Recommended Test Frequencies and Levels

To ensure that rated specifications are maintained and to prevent setting errors, the following preparations must be made prior to checking the rated characteristics:

- At least **30 minutes warmup period**.
- All **internal calibrations** must be carried out (see Chapter 2)
- A defined initial status must be set by pressing the **PRESET key** prior to making the settings for a new measurement.

In the following sections, the procedures for checking the rated specifications are described. **The binding nominal values are specified in the data sheet.**
lists the sampling frequencies for internal calibration (with and without vector modulation). For a full functional test of the instrument, we recommend measurements at these frequencies unless particular test frequencies are given.
The asterisk (*) marks range limits which constitute the main test frequencies.

Table 5-2 Range limits, main test frequencies with/without vector modulation

Test frequency	Remarks
300 000.0 Hz	*
500 000.0 Hz	
1 000 000.0 Hz	
2 000 000.0 Hz	
3 000 000.0 Hz	
5 000 000.0 Hz	*
5 000 000.1 Hz	*
7 000 000.0 Hz	
10 000 000.0 Hz	
15 000 000.0 Hz	
20 000 000.0 Hz	
25 000 000.0 Hz	
50 000 000.0 Hz	
Every 50 MHz up to 6400 000 000.0 Hz	*

The following range limits **and the 0.1 Hz higher frequencies** are further main (*) frequencies:

General range limits, CW:	450 MHz, 1500 MHz, 3000 MHz, 3040 MHz
General range limits, VM:	525 MHz, 750 MHz,1200 MHz, 1800 MHz, 2500 MHz
General range limits, CW and VM:	3300 MHz, 4200 MHz, 5100 MHz, 6000 MHz, 6400 MHz
Oscillator switchover, CW:	1100 MHz, 2200 MHz
Oscillator switchover, VM:	800 MHz, 1500 MHz

Because of the different level algorithms used, the test levels are given separately for the different models. With attenuator switching in steps of 5 dB, it is also possible to perform measurements at lower levels (for example if mixers are used) by lowering the level exactly in 5.0 dB steps. For Signal Analyzer FSIQ, the optimum mixer level is –15 dBm (ie –5 dBm at 10 dB attenuation); the level of the SMIQ should have this value.

Model	Pcw_{max}	Pcw_{min}	Pvm_{max}	Pvm_{min}	Pam_{max}	Pam_{min}
02, 03, ..A,..E, ..W	10.0 dBm	5.1 dBm	7.0 dBm	2.1 dBm	7.9 dBm at 80% 10.7 dBm at 30%	2.1 dBm
02B, 03B	10.0 dBm	5.1 dBm	8.0 dBm	3.1 dBm	7.9 dBm at 80% 10.7 dBm at 30%	2.1 dBm
04B, 06B	7.0 dBm	2.1 dBm	5.0 dBm	0.1 dBm	4.9 dBm at 80%, 7.7 dBm at 30%	-0.9 dBm

5.3 Test Procedures

5.3.1 Display and Keyboard

Checking the display	➢ Switch instrument on. ⇨ The basic menu is displayed after several seconds. ➢ Rotate contrast control (lefthand potentiometer below the display). ⇨ The contrast is varied from dark to bright. ➢ Rotate brightness control (righthand potentiometer). ⇨ The brightness of the backlighting is varied.
Checking the keyboard	➢ Press keys and check response at the display.

5.3.2 Frequency

5.3.2.1 Frequency Setting

Test equipment	Frequency counter (Table 5-1, item 1)
Test method	The frequency setting is checked using a frequency counter whose reference frequency is synchronized with that of the SMIQ.
Measurement	➢ SMIQ setting: - test frequency unmodulated, - level 0 dBm ⇨ The measured values must be exact within the framework of the counter resolution.

Recommended test frequencies:

CW test frequency	**Module under test**
839.1, 839.15, 839.5 MHz	Digital synthesis
840 to 940 MHz in 10 MHz steps	Step synthesis
800, 850, 1000, 1100, 1200, 1300, 1400, 1490 MHz	Harmonics of summing circuit
450.1, 750 MHz	Divider and harmonic filter of IQ converter
10, 449 MHz	Output mixer of IQ modulator
1501, 2200, 2500, 3300 MHz	Doubler with filters IQCON
3750 MHz, 4400 MHz, 5550 MHz, 6400 MHz	Frequency extension
VM test frequencies, max. level	
500, 800, 1801, 2200, 3300 MHz	Doubler with filters IQCON

5.3.2.2 Settling Time

Test assembly

See section "Test Assemblies".

Test method

The spectrum analyzer is operated as an edge demodulator with a 0 Hz span. A controller transmits the start and the stop frequency via the IEC bus. The storage oscilloscope is connected to the video output of the analyzer and triggered by the positive edge on the EOI line of the IEC bus. When the controller switches over from start to stop frequency, the settling procedure is displayed on the screen of the storage oscilloscope.

Preparation of measurement

➢ Synchronize the reference frequencies of the SMIQ and the analyzer.

➢ Make IEC bus and RF connections.

➢ Connect storage oscilloscope to video output of analyzer.

➢ Apply trigger connection to EOI line (pin 5) of IEC bus.

➢ Settings on SMIQ:
- Stop frequency unmodulated
- Level 0 dBm

➢ Settings on storage oscilloscope:
- Time base > settling time to be measured
- Sensitivity corresponding to video output of analyzer
- Free-running trigger for calibration

➢ Settings on spectrum analyzer:
- Reference level -5 dBm
- Amplitude scale 1 dB/div
- Resolution bandwidth 10 kHz
- Video bandwidth 100 kHz
- Span 30 kHz

➢ Starting from the stop frequency, lower the center frequency of the analyzer until the visible filter edge runs through the center point of the screen.

➢ Reduce the span to 0 Hz and calibrate the frequency scale at the (free-running) oscilloscope by means of 100 Hz steps on the SMIQ.

Measurement

➢ Settings on storage oscilloscope as above
- External triggering by positive edge at 1.5 V.

➢ First send the start and then the stop frequency from the controller.

⇨ The settling curve is displayed on the screen of the externally triggered oscilloscope.

➢ Repeat the measurement with the start and the stop frequency interchanged.

⇨ Measure the following steps in both directions:

Test	Setting	F1/MHz	F2/MHz
Step synthesis	CW	840	942
Digital synthesis	CW	1 350.2	1 351.4
Mixer range	CW	1 099	5
Doubler, oscillator change	CW	2201	1099
CW/VM synthesis, 3rd filter	CW	2999	3 001
1st/2nd filter	VM max. level, ALC table	751	1801
2nd/3rd filter	VM max. level, ALC table	1801	2601
Frequency extension	CW	3000	3301
Frequ. extension, 1st/2nd filter	CW	4199	4201
Frequ. extension, 2nd/3rd filter	CW	5099	5101
Frequ. extension, 3rd/4th filter	CW	5999	6001

QuickBasic program for the controller

```
CLS
iecadresse% = 28                                          IEC-bus address of SMIQ (28)
CALL IBFIND("DEV1", generator%)                    Open DEV1 and obtain access number
CALL IBPAD(generator%, iecadresse%)                   Set IEC-bus address of DEV1 to 28
iecterm% = &HA '                                                Set EOS to LINE FEED
CALL IBEOS(generator%, iecterm% + &H800)
CALL IBWRT(generator%, "POW 0dBm")
DO
  INPUT "Start frequency in MHz";F1$
  INPUT "Stop frequency in MHz";F2$
  DO
   CALL IBWRT(generator%, "FREQ" + F1$ + "MHz")
   PRINT "Frequency:";F1$; "MHz"
   DO '                                                                   Press any key
     kbd$ = INKEY$
   LOOP UNTIL LEN(kbd$)
   SWAP F1$, F2$
  LOOP UNTIL kbd$ = CHR$(27) '                                         Exit with ESCAPE
  INPUT "Repeat (y/n)"; w$
LOOP UNTIL NOT UCASE$(w$) = "Y"
END
```

5.3.3 Reference Frequency

5.3.3.1 Output of Internal Reference

Important: *Allow SMIQ to warm up for at least 2 hours before the measurement.*

Test equipment	Frequency counter (Table 5-1, item 1)
Test setup	➢ Connect a calibrated frequency counter to output REF (socket on rear panel).
Measurement	➢ Measure the frequency. ⇨ The frequency deviation must not exceed the sum of deviations resulting from the frequency error in the rated temperature range and from aging.

5.3.3.2 Input for External Reference

Test equipment	Frequency counter (Table 5-1, item 1) Signal generator (Table 5-1, item 5)
Test setup	➢ Connect the signal generator to the input for the external reference and connect a calibrated frequency counter to the RF output.
Measurement	➢ Measure the frequency with the setting UTILITIES/REF OSC/SOURCE EXT. ⇨ *The pull-in range has to be tested only at 10 MHz input frequency by measuring the output frequency (eg at 100 MHz). There must be no relative frequency error and no error message. At the other input frequencies (1 MHz to 16 MHz in steps of 1 MHz), a function test at nominal frequency is sufficient. The level of the signal generator should be -7 dBm, for the function tests it should be raised to 16 dBm.*

5.3.4 Level

5.3.4.1 Level Frequency Response and Linearity

Test equipment	- Power meter (Table 5-1, item 8) - Precision attenuator (Table 5-1, item 9) - Spectrum analyzer (Table 5-1, item 2) - Low-noise preamplifier (Table 5-1, item 10)

Test method for levels in measurement range of power meter

Test setup	➢ Connect power meter to RF output socket.
Measurement	➢ Setting on SMIQ: - RF level to be measured (see below), unmodulated ➢ Measure the level at output frequencies of 300 kHz to RF_{max} (Table 5-2). ⇨ The frequency response is the difference between the highest and the lowest value measured. ⇨ The level error is the deviation from the set value.
Recommended test levels	Pcw_{max}, Pcw_{min} and from Pcw_{min} in -5 dB steps to the measurement limit of the power meter

Test method for low levels

Test method

Levels below the measurement range of the power meter can be measured by means of a comparison measurement using a precision attenuator and a sensitive test receiver or spectrum analyzer. The reference is a measurement using the power meter at the reference level, in this case Pcw_{max}.

Test setup

- ➢ Connect a precision attenuator to the RF output of the SMIQ, connect a spectrum analyzer with RF-shielded test cables to the output of the precision attenuator.

Measurement

- ➢ Settings on SMIQ:
  - Test frequency
  – Reference level, unmodulated
- ➢ Setting on test receiver or analyzer:
  - Test frequency
- ➢ Setting on attenuator:
  - 120 dB attenuation
- ➢ Read the level from the test receiver or the analyzer and note it down as a reference value. Pcw_{max} should be approx. –120 dBm. Select the test bandwidth small enough to ensure an exact reading.
- ➢ Repeat the measurement with the settings given in the table.

  ⇨ The deviation of the value displayed on the analyzer from the reference value is the level error.

Level on SMIQ	**Attenuation of attenuator**
Reference level	120 dB
Reference level -5 dB	115 dB
Reference level -10 dB	110 dB
Reference level -20 dB	100 dB
Reference level -40 dB	80 dB
Reference level -60 dB	60 dB
Reference level -80 dB	40 dB
Reference level -100 dB	20 dB
Reference level -120 dB	0 dB

Test method for lowest levels

Important: *The measurement will be correct only if there is no RF leakage of the components used.*

Test setup

- ➢ Connect a low-noise preamplifier between the SMIQ and the precision attenuator.

Measurement

- ➢ Make a subsequent calibration for a level already measured.

  ⇨ This allows levels to be measured down to the lower setting limit of the SMIQ.

5.3.4.2 Output Impedance

Test assembly

See section "Test Assemblies".

Test method

Since the VSWR of a source must be measured, a purely passive measurement using the VSWR bridge is only possible with levels where the VSWR is determined by the output impedance of the mechanical attenuator only.

With higher levels, the effect of level control must be taken into account. For this purpose, an auxiliary generator is used which transmits a wave with a slightly offset carrier frequency (difference frequency within the control bandwidth of the level control) into the DUT, on which the outgoing wave of the DUT is superimposed. In the case of an ideal source impedance, only the outgoing wave of the DUT flows back into the bridge, in the case of a deviating source impedance, the two components are superimposed on one another, which, due to the frequency offset, results in a beat, from the amplitude ratio of which the VSWR can be derived.

Measurement

- ➢ Settings on SMIQ:
  - Test level
  - Test frequency, unmodulated
- ➢ Settings on spectrum analyzer:
  - Test frequency, span 0 Hz, test level
  - Resolution and video bandwidth 10 kHz
  - Linear level scale
  - Sweep time 30 ms
- ➢ Settings on second signal generator:
  - Detune the frequency by 100 Hz compared to the test frequency,
  - first set minimum level, unmodulated.
- ➢ Vary the reference level to bring the line displayed on the screen of the spectrum analyzer approximately into the center of the screen and read and note down the level as reference level.
- ➢ Unscrew the VSWR bridge from the SMIQ and increase the level at the second signal generator until the reference level is measured again at the analyzer.
- ➢ Screw the bridge or directional coupler onto the SMIQ again.

  ⇨ A more or less wavy line representing the VSWR of the SMIQ is now displayed on the spectrum analyzer.

  The VSWR is to be calculated from the maximum and minimum voltage

$$\mathrm{VSWR} = V_{max}/V_{min}$$

Passive measurement of VSWR with output levels of SMIQ below -30 dBm

➤ Settings on SMIQ:
  - Test level
  - Frequency far from test frequency, unmodulated

➤ Settings on second signal generator:
  - Test frequency
  - Level 10 dBm

➤ Unscrew the VSWR bridge from the DUT and note down the level measured at the analyzer as reference value.

➤ Screw on the bridge or directional coupler again and determine the new level at the analyzer.

⇨ The voltage ratio of test level to reference level is the output reflection coefficient r of the DUT.

The voltage standing wave ratio (VSWR) can be calculated according to the formula

$$\mathrm{VSWR} = (1+r)/(1-r)$$

5.3.4.3 Settling Time

Test assembly

See section "Test Assemblies".

Test method

The spectrum analyzer is operated as a fast level meter with a span of 0 Hz. A controller transfers the start and the stop level via the IEC bus. The storage oscilloscope is connected to the video output of the analyzer and triggered by the positive edge on the EOI line of the IEC bus. When the controller switches over from start to stop level, the settling procedure is displayed on the screen of the storage oscilloscope.

Preparation of measurement

➤ Synchronize the reference frequencies of the SMIQ and the analyzer.

➤ Make IEC-bus and RF connections.

➤ Connect storage oscilloscope to video output of analyzer.

➤ Apply trigger connection to EOI line (pin 5) of IEC bus.

➤ Setting on SMIQ:
  - Test frequency 1GHz

➤ Settings on storage oscilloscope:
  - Time base 5 ms/div
  - Sensitivity according to video output of analyzer

➤ Settings on spectrum analyzer:
  - Reference level 10 dBm
  - Amplitude scale 10 dB/div
  - Resolution bandwidth 300 kHz
  - Video bandwidth 300 kHz
  - Span 0 Hz

Measurement

➤ Setting on storage oscilloscope:
  - External triggering by positive edge at 1.5 V

➤ First send the start and then the stop level from controller.

⇨ The level characteristic from the trigger point is displayed on the screen of the externally triggered oscilloscope.

➤ Repeat the measurement with the start and the stop level interchanged.

⇨Measure the following steps in both directions:

Setting	Start level	Stop level	Remarks
CW	–140 dBm	Pcw_{max}	With mechanical attenuator, in direction of stop level only
CW, FM 10 kHz	Pcw_{max} –35	Pcw_{max}	With mechanical attenuator
CW, FM 10 kHz	Pcw_{min}	Pcw_{max}	Without mechanical attenuator
AM 30%	Pam_{min} –35	Pam_{min}	With mechanical attenuator
AM 30%	Pam_{min}	Pcw_{max}	Without mechanical attenuator

QuickBasic program for the controller

```
CLS
iecadresse% = 28                                      IEC-bus address of SMIQ (28)
CALL IBFIND("DEV1", generator%)                 Open DEV1 and obtain access number
CALL IBPAD(generator%, iecaddress%)              Set IEC-bus address of DEV1 to 28
iecterm% = &HA '                                           Set EOS to LINE FEED
CALL IBEOS(generator%, iecterm% + &H800)
CALL IBWRT(generator%, "FREQ 1GHz")
DO
  INPUT "Start level in dBm";P1$
  INPUT "Stop level in dBm";P2$
  DO
   CALL IBWRT(generator%, "POW" + P1$ + "dBm")
   PRINT "Level: ";P1$; "dBm"
   DO '                                                             Press any key
     kbd$ = INKEY$
   LOOP UNTIL LEN(kbd$)
   SWAP P1$, P2$
  LOOP UNTIL kbd$ = CHR$(27) '                                   Exit with ESCAPE
  INPUT "Repeat (y/n)"; w$
LOOP UNTIL NOT UCASE$(w$) = "Y"
END
```

5.3.4.4 Non-Interrupting Level Setting (ATTENUATOR MODE FIXED)

Test equipment	Spectrum analyzer (Table 5-1, item 2)
Test setup	➢ Connect the analyzer to the RF output of the SMIQ.

Measurement

➢ Settings on SMIQ:
- Recommended test frequencies: 5, 100, 1000, 1500, 2200, 3300, 3301, 4400, 5000, 6400 MHz, unmodulated
- Level Pcw_{min}
- Select FIXED in the menu LEVEL/LEVEL ATTENUATOR MODE.

➢ Note down the level read from the analyzer as reference value or set the delta marker to 0 dB for relative measurement.

➢ Reduce the level on the SMIQ in 5 dB steps.

⇨ The following deviations should not be exceeded:

Attenuation in dB ATT FIXED	**Tolerance in dB**
5	0.4
10	0.6
15	1.2
20	2.0
Attenuation in dB ATT ELEC	
35	1
70	1.8
80	3.0

5.3.4.5 Overvoltage Protection (if provided)

Test equipment

- Adjustable DC voltage source (Table 5-1, item 12)
- Signal generator (Table 5-1, item 5)
- Power amplifier (Table 5-1, item 13)

Test setup

➤ Connect an adjustable DC voltage source to the RF output socket of the SMIQ via a 50 Ω resistor or a signal generator with a subsequent power amplifier with a power output of more than 1 W.

Measurement

➤ Settings on SMIQ:
- Frequency 100 MHz, unmodulated
- Level -120 dBm

➤ Apply the DC voltage via the 50 Ω resistor.

⇨ The overvoltage protection must respond at a voltage > 4 V and < 7 V for both polarities.

➤ Connect the signal generator to the RF output socket of the SMIQ via the power amplifier and apply frequencies of up to RF_{max}. Increase the level at each frequency, starting with 0.1 W.

⇨ The overvoltage protection should respond at an RF power of 1 W at the latest.

5.3.5 Spectral Purity

5.3.5.1 Harmonics Suppression

Test equipment

Spectrum analyzer (Table 5-1, item 2)

Test setup

➤ Connect the spectrum analyzer to the RF output of the SMIQ.

Measurement

➤ Settings on SMIQ:
- Test frequencies according to Table 5-2, unmodulated
- Level Pcw_{max} according to data sheet

➤ Settings on analyzer:
- Reference level = test level + 10 dB, 10 dB/div.
- Span 300 kHz, resolution 30 kHz

➤ First measure the level of the fundamental as a reference. Then find signals at twice and three times the carrier frequency. Make sure not to overdrive the spectrum analyzer.

⇨ The harmonics level is the level of the harmonic found referred to the output signal of the DUT (dBc = referred to carrier).

5.3.5.2 Nonharmonics Suppression

Test equipment	Same as for harmonics suppression
Test setup	Same as for harmonics suppression
Measurement	➢ First measure the level of the output signal as a reference, then find a signal at the sampling frequency. ⇨ The nonharmonics level is the level of the nonharmonic found referred to the output signal of the DUT (dBc = referred to carrier).
Recommended settings on spectrum analyzer	➢ - Span 0 Hz - Resolution bandwidth 1 kHz - Video bandwidth 30 Hz - Sample detector ➢ Synchronize the reference frequencies of the analyzer and the DUT.

Note: *The above values are approximate values dependent on the analyzer used. The required suppression is to be verified prior to the measurement.*

Recommended settings and sampling frequencies:

Nonharmonics of step synthesis at test level Pcw_{min}, unmodulated

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz	Corresponds to suppression df in kHz
831.0	831.6896	689.6
832.7	833.3993	699.3
1044.5	1045.0988	598.8
1043.0	1043.5917	591.7
1139.6	1140.1181	518.1
1141.0	1141.5235	523.5
1457.5	1458.4174	917.4
1349.6	1350.5345	934.5
1444.0	1444.8264	826.4
1446.0	1446.8403	840.3
1430.5	1431.2519	751.9
1434.1	1434.8634	763.4

Nonharmonics of summing circuit at test level Pcw_{min}, unmodulated

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz	Corresponds to suppression df in Hz
1412.9	1413.2	300.0k
1305.4	1305.7	300.0k
1197.9	1198.2	300.0k
1090.4	1090.7	300.0k
838.25	838.3676	117.6k
380	380.4255	425.5k
1495.59	1511.18	15.59M
1354.0625	1368.3192	14.2567M
1354.0625	1382.5758	28.5133M

Nonharmonics IQMOD at test level Pcw_{min}, unmodulated

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz
451	300, 600, 1200, 2400, 3000
449.9	600, 1200, 2400
225	600, 1200, 2400
70.0	600, 1200, 2400

Nonharmonics of output mixer IQMOD at test level Pcw_{max}, unmodulated

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz
449	1053, 1951, 2849
449.9	1050.3, 600.4
225	1725
70.0	2190

Nonharmonics of IQ synthesis at test level Pvm_{min}, VM at max. level

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz
751	600
901	900
751	1051, 1351
1450	1750, 2050, 1150, 850
1800	2100
1801	1501, 3002
2150	1850, 2450
2500	2200
2501	2201
2900	2600, 2300
3200	2900, 3500
595	305
1	299
149	151
524	752, 452
401	698

Nonharmonics of output mixer IQMOD at test level Pvm_{max}, VM at max. level

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz
580	660
749.99	900.02

Nonharmonics of module E6GHZ at test level Pcw_{min}, unmodulated

Setting on SMIQ Frequency in MHz	Sampling frequency in MHz
3301, 3350, 50 MHz steps up to 6400 MHz	1200, 2400, 3600
Same as above	+-300, 600 MHz from carrier
Same as above	+-900 MHz from carrier
3301, 3350, 50 MHz steps up to 5100 MHz	0.5*(f+900 MHz)
5101, 5150, 50 MHz steps up to 6400 MHz	0.5*(f-900 MHz)

Non-systematic nonharmonics

Measurement

➢ Settings on SMIQ:
  - Test frequencies: 93, 520, 749, 751, 1799, 2200, 2499, 2501, 3300, 3301, 4199, 4400, 5099, 5101, 5999, 6001, 6400 MHz
  - Test levels Pcw_{min} unmodulated and Pvm_{min} with vector modulation at max. level

➢ Recommended settings on analyzer:
  - Sample detector
  - Sampling far from the carrier:
    Resolution bandwidth 30 kHz
    Video bandwidth 1 kHz
    Span 10 MHz
  - Sampling at 50 kHz to 1 MHz from the carrier:
    Resolution bandwidth 3 kHz
    Video bandwidth 300 Hz

5.3.5.3 Broadband Noise

Test assembly

Connect spectrum analyzer to RF socket of SMIQ.

Test method

Operate the spectrum analyzer in the CHANNEL POWER mode. Set SPAN to 400 kHz, channel bandwidth to 350 kHz, detector to SAMPLE, attenuator to LOW NOISE, and PLL bandwidth with COUPLING/MAIN PLL BANDWIDTH to LOW. For reference level measurement, set the center frequency of the analyzer to the test frequency, set the reference level to the test level, and read the channel power. Then measure the reference level by shifting the center frequency by the desired offset (for example 5 MHz). The channel power now displayed must be converted to 1 Hz bandwidth and referred to the carrier power. By performing a measurement without input level, the analyzer's inherent noise can be determined and subtracted if necessary.

Measurement

- Determine the channel power with the center frequency of the analyzer set to the test frequency and note it down as P_{ref}.
- Increase the center frequency by the offset (5 MHz).
- Lower the reference level of the analyzer by 20 dB, read the new channel power P_{noise} and note it down.
- Minimize the output level on the SMIQ by means of RF OFF, read the channel power P_{res} and note it down.

Evaluation

- If the power P_{res} is lower than P_{noise} by more than 1 dB and less than 10 dB, the inherent noise power of the analyzer can be subtracted. To this effect, convert the two power values into mW according to the formula $PmW = 10^{(PdBm/10)}$, then subtract P_{res} from P_{noise}. Reconvert the corrected power into dBm according to the formula PdBm = 10*log10(PmW).
- If the power P_{res} is less than 1 dB below the power P_{noise}, the analyzer resolution is not sufficient for a precise measurement. The true result is in such case certainly more than 6 dB below the measured value. If P_{res} is more than 10 dB below P_{noise}, P_{noise} need not be corrected since the noise component of the analyzer is negligible.
- Convert the power P_{noise} to 1 Hz bandwidth according to the formula P1Hz = Pch - (10*log10(channel bandwidth)).

⇨The difference between the (possibly corrected) power P_{noise} in dBm and the power P_{ref} in dBm is the broadband noise floor in dBc.

Recommended test frequencies

See Table 5-2, at least * frequencies.

5.3.5.4 SSB Phase Noise

Test assembly

See section "Test Assemblies"

Test method

The two signal generators are set to the test frequency and synchronized with a phase offset of 90° (phase quadrature). Mixing to 0 Hz suppresses the RF carrier, and due to the phase quadrature the mixer supplies a voltage corresponding to the phase difference between the input signals. This is measured by the LF spectrum analyzer and can be converted into SSB phase noise.

Measurement

- Set the levels of the two signals generators in accordance with the specifications of the mixer used (unmodulated or vector modulation with max. level).
- For calibration, reduce the level of the DUT by 40 dB and detune one signal generator by 20 kHz. Check the signal for harmonics; the 2nd and 3rd harmonic should be more than 30 dB below the fundamental. Measure the reference value at 20 kHz at the analyzer and note it down.
- Set the detuned signal generator to the previous frequency and set the signal generators for phase quadrature. To this end, raise the level of the DUT to the previous level and call PHASE in the UTILITIES menu. Observe the output voltage of the mixer on the oscilloscope and vary the phase until the voltage becomes 0.
- Read the noise voltage, normalized to a bandwidth of 1 Hz (noise level) from the analyzer.

Evaluation

- Determine the difference relative to the reference level and add to the value found 6 dB for the second sideband measured (correlated) and 40 dB for level switchover.
  If the S/N ratio of the second signal generator is not at least 10 dB better than that of the DUT, the noise component of the reference signal generator must be determined and subtracted as well.

  ⇨ The corrected S/N ratio is the wanted measured value.

Example: *The measured reference level is assumed to be 12 dBm. A noise level of -78 dBm (1 Hz) is determined at 20 kHz. The difference is 90 dB, plus the correction for the second sideband (6 dB) and level switchover (40 dB), yielding an S/N ratio of -136 dB or a noise level of -136 dBc (dB referred to the carrier power). If two identical signal generators have been used, the result must be reduced by 3 dB for the (uncorrelated) noise power of the reference signal generator.*

The final result is then -139 dBc.

5.3.5.5 Residual FM

Note: *The measurement of SSB phase noise usually makes a measurement of residual FM superfluous as it is more sensitive.*

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Frequency 1 GHz - Level Pcw_{max}, unmodulated ➢ Setting on analyzer: - Demodulation FM, rms value ➢ Determine the residual FM with ITU-T(CCITT) filtering and with a test bandwidth of 30 Hz to 23 kHz.

5.3.5.6 Residual AM

Test assembly	Same as above.
Measurement	Same as above, but with AM demodulation.

5.3.6 Sweep

Test equipment	DC voltmeter (Table 5-1, item 19)
Test setup	➢ Connect the voltmeter to the X-AXIS, MARKER or BLANK socket of the SMIQ.
Measurement	➢ Settings on SMIQ: Set any sweep with 10 steps. Define a marker in the sweep range. ➢ Select LONG as SWEEP BLANK TIME. ➢ Select all steps in the STEP mode and measure the voltage at the sockets X-AXIS and MARKER. ➢ The voltage at X-AXIS should rise proportionally to the sweep steps from 0 to 10 V. Tolerance: ±5% ±30 mV. ➢ The voltage at MARKER should go "high" when the marker step is selected, otherwise it should remain "low". ➢ Perform a SINGLE sweep to check the BLANK output. After the end of the sweep, the voltage at the BLANK output should go "high".

It is sufficient to perform the test in one sweep mode.

5.3.7 Internal Modulation Generator

Test equipment

Audio analyzer (Table 5-1, item 14)

Test setup

- ➢ Connect the audio analyzer to the LF socket of the SMIQ.
  For frequency measurements above 100 kHz, connect the spectrum analyzer.

Measurement

- ➢ Settings on SMIQ:
  - LF OUTPUT menu:
    SOURCE LFGEN
    VOLTAGE 1 V
    Vary LFGEN FREQUENCY from 0.1 Hz to 1 MHz.
- ➢ Read the actual frequency from the audio or spectrum analyzer.
- ➢ Read the distortion from the audio analyzer.

Recommended settings for frequency	1 kHz, 33.3333 kHz, 1 MHz
Recommended settings for distortion	20 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz

Measurement

- ➢ Settings on SMIQ:
  - LF OUTPUT menu:
    Set LFGEN2 FREQUENCY to 1 kHz.
  - Vary VOLTAGE from 1 mV to 4 V.
- ➢ Measure the output level with the audio analyzer.

Recommended settings	3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 2 V, 4 V

Frequency response

Test equipment

AC voltmeter (Table 5-1, item 19)

Test setup

- ➢ Connect the AC voltmeter to the LF socket of the SMIQ.

Measurement

- ➢ Settings on SMIQ:
  - LF OUTPUT menu:
    SOURCE LFGEN
    Vary LFGEN FREQUENCY from 10 Hz to 1 MHz.
- ➢ Measure the frequency response.
  ⇨ The frequency response is the difference between the highest and the lowest level.

Note: *The required settling time is a pure computer time and need therefore not be measured.*

5.3.8 Vector Modulation

5.3.8.1 Input Impedance (VSWR)

Test equipment

Test assembly for output impedance

Test setup

- ➢ Connect the test port to the I or Q input instead of the RF output.

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm
  - Carrier frequency 900 MHz
  - Switch on vector modulation.
- ➢ Settings on signal generator:
  - Level 10 dBm
  - Carrier frequency 5, 10 and 30 MHz
- ➢ Screw the VSWR bridge off and measure the level as reference level.
- ➢ Connect the VSWR bridge to the I input and measure the level again.
  - ⇨ The voltage ratio of test level to reference level is the output reflection coefficient r of the DUT.
- ➢ From this, the voltage standing wave ratio (VSWR) can be calculated as follows:

  $$VSWR = (1+r)/(1-r)$$
- ➢ Repeat the measurement for the Q input.

5.3.8.2 Maximum Level

Test equipment

- Power meter (Table 5-1, item 8)
- DC voltage source (Table 5-1, item 12)

Test setup

- ➢ Connect the power meter (Table 5-1, item 8) to the RF output socket.
- ➢ Connect the DC voltage source to the I or Q input.

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm
  - Carrier frequency 900 MHz
- ➢ Measure the level without modulation as reference level.
- ➢ Select STATE ON in the menu VECTOR MOD. Set the DC voltage source to 0.500 V. Measure the level again.
  - ⇨ The level difference should be within the permissible tolerance specified in the data sheet.

5.3.8.3 Error Vector

Test assembly

See section "Test Assemblies", vector modulation

Measurement

Instead of a static measurement, an equivalent dynamic measurement with a low symbol rate is carried out.

- ➢ Settings on SMIQ:
  - Level 0 dBm
  - Select STATE ON in the menu VECTOR MOD.
- ➢ Generate a modulation signal on the ARB generator using the controller and the simulation program:
  - Modulation 16QAM
  - No coding
  - √cos filter with $\alpha = 0.5$
  - PRBS-9 data sequence
  - Pulse width and oversampling 32
  - Length 100 symbols
  - Symbol clock 10 kHz
- ➢ Check if the channels on the ARB generator are equal and adjust if necessary.
- ➢ Make the corresponding settings on the demodulator. Synchronize to a bit sequence, starting with the 9th symbol, 12 bits long, result length 80 symbols.
- ➢ Vary the carrier frequency from 5 MHz to RF_{max}.
  For recommended setting values see Table 5-2, at least
  * frequencies.
- ➢ Measure the error vector magnitude (peak and rms) on the demodulator.

5.3.8.4 Modulation Frequency Response

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- Signal generator (Table 5-1, item 5)

Test setup

- ➢ Connect the RF output of the SMIQ to the spectrum analyzer, connect the signal generator to the I input of the SMIQ.

Test method

By applying a sinewave AC voltage to the I (or Q) input, an amplitude modulation with a suppressed carrier is generated. The modulation frequency response is determined by measuring the sidebands as a function of the frequency of the applied AC voltage.

Measurement

- ➢ Settings on SMIQ:
  - Test level 0 dBm, test frequency > 30.3 MHz
  - Select STATE ON in the menu VECTOR MOD.
- ➢ Setting on signal generator:
  - Level 0.5 V (V_{peak}) corresponding to 4 dBm
- ➢ Settings on analyzer:
  - Center frequency = test frequency, span 3 MHz to 62 MHz
  - Reference level = test level +6 dB
  - Scale 2 dB/div
- ➢ Vary the frequency from 1 MHz to 30 MHz on the signal generator and observe the modulation sidebands on the analyzer using an appropriate span.

  ⇨ The result level for a sideband frequency is the average value of the left and the right sideband level.
- ➢ For evaluation, determine the difference between the modulation sidebands and the first sideband at 1 MHz.

  ⇨ The modulation frequency response is the difference between the highest and the lowest sideband.

5.3.8.5 Residual Carrier and Leakage

Test equipment

Spectrum analyzer (Table 5-1, item 2)

Test setup

- ➢ Connect the spectrum analyzer to the RF output of the SMIQ.

Measurement

- ➢ Settings on SMIQ:
  - Test frequencies according to Table 5-2, unmodulated
  - Test level Pvm_{max}
  - Select STATE OFF in the menu VECTOR MOD/STATE.
- ➢ Settings on analyzer:
  - Center frequency = test frequency, span 1 MHz
  - Reference level = test level
  - Scale 10 dB/div
- ➢ First measure the unmodulated level as a reference.
- ➢ Then switch on vector modulation with open inputs (STATE ON) and measure the residual carrier.

  ⇨ The residual carrier in dBc is the level of the residual signal found referred to the output signal of the DUT without modulation (dBc = referred to the carrier).
- ➢ Set IMPAIRMENT STATE ON and LEAKAGE 10% on the SMIQ.

  ⇨ The residual carrier should increase to 10% (-20 dBc).

5.3.8.6 I/Q Imbalance

Measurement of imbalance

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- Adjustable DC voltage source (Table 5-1, item 12)

Test setup

➢ Connect the spectrum analyzer to the RF output of the SMIQ.

➢ Connect the DC voltage source to the I or the Q input.

Measurement

➢ Settings on SMIQ:
- Test frequency 900 MHz
- Test level 0 dBm
- Select STATE ON in the menu VECTOR MOD.

➢ Settings on analyzer:
- Center frequency = test frequency, span 1 MHz
- Reference level = test level +3 dB
- Scale 1 dB/div

➢ First measure the undistorted level as a reference. To this end, apply a DC voltage of 0.500 V to the I and then to the Q input and note down the corresponding RF levels as reference levels.
In the menu VECTOR MOD/IMPAIRMENT STATE, select ON and IMBALANCE 10%. Repeat the level measurements.

⇨ The I level should increase by the set imbalance, the Q level decrease by the inverse ratio. With 10%, the I level should increase to 1.1 times, the Q level decrease to 1/1.1 times the original value, ie the Q level should be reduced to 0.909 times the original value (corresponding to ±0.83 dB).

Measurement quadrature error

Test assembly

See section "Test Assemblies", vector modulation

Measurement

➢ Settings on SMIQ:
- Level 0 dBm
- Test frequency 900 MHz
- In the menu VECTOR MOD, select STATE ON,
  IMPAIRMENT STATE OFF, QUADRATURE ERROR 10°.

➢ Generate a modulation signal using the controller and the simulation program:
- Modulation 16QAM
- No coding
- √cos filter with α = 0.5
- PRBS-9 data sequence
- Pulse width and oversampling 32
- Length 100 symbols
- Symbol clock 10 kHz

➢ Make the corresponding settings on the demodulator. Synchronize to a bit sequence, starting with the 9th symbol, 12 bits long, result length 80 symbols.

➢ Select the vector representation on the demodulator.

⇨ The symbols should be located in a square grid.

➢ Select IMPAIRMENT STATE ON on the SMIQ.

⇨ The symbols must no longer be arranged at right angles; the Y axis should be inclined towards the left by 10°, with a setting of -10° it should be inclined towards the right.

5.3.8.7 Level Control POW RAMP

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- 2 adjustable DC voltage sources (Table 5-1, item 12)
- Function generator (Table 5-1, item 18 or 24)
- Digital storage oscilloscope (Table 5-1, item 3)

Test setup

➢ Connect the spectrum analyzer to the RF output of the SMIQ.

➢ Connect the 1st DC voltage source to the I input with 0.50 V.

➢ Connect the 2nd DC voltage source to the POW RAMP input.

Measurement

➢ Settings on SMIQ:
- Test frequency 900 MHz
- Level 0 dBm
- Select STATE ON in the menu VECTOR MOD.

➢ Settings on analyzer:
- Center frequency = test frequency, span 1 MHz
- Reference level = test level
- Scale 10 dB/div

➢ First measure the non-attenuated level with 1.00 V at the POW RAMP input as a reference. Then reduce the voltage to 0.100 V and measure the level again.

⇨ A value 20 dB lower is now expected. The attenuation error at -20 dB is the deviation of this level from the expected value.

➢ Reduce the voltage to 0.00 V and determine the residual level.

⇨ The on/off ratio is the residual level referred to the reference level at 1 V.

Test setup

➢ To measure the dynamic characteristics, connect a function generator to the POW RAMP input.

➢ Connect one channel of the storage oscilloscope to the video output of the analyzer and the other one to the input signal from the function generator.

Measurement

➢ Setting on function generator:
- Squarewave signal with offset, lower level 0.1 V, upper level 1.0 V, frequency 100 kHz

➢ Settings on analyzer:
- Center frequency = test frequency, span 0 Hz
- Reference level = test level
- Scale 10 dB/div
- Resolution and video bandwidth 10 MHz

➢ Trigger on the input signal on the oscilloscope and evaluate the blanked RF signal on the oscilloscope.

⇨ Rise time = time between 10% and 90% of RF amplitude
Fall time = time between 90% and 10% of RF amplitude
Delay = time between 50% of input amplitude and 50% of RF amplitude

5.3.9 Amplitude Modulation

5.3.9.1 Modulation Depth Setting

Test assembly

See section "Test Assemblies", standard test assembly for analog modulations

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm
  - Select INT in the menu ANALOG MOD/AM/AM SOURCE INT,
    Modulation depth 0.1% to 80%
    Modulation frequency 1 kHz
- ➢ Vary the carrier frequency from 5 MHz to RF$_{max}$. For recommended setting values see Table 5-2, at least * frequencies.
- ➢ Read the modulation depth from the modulation analyzer.

5.3.9.2 AM Distortion

Test assembly

See section "Test Assemblies", standard test assembly for analog modulations

Measurement

- ➢ Settings on SMIQ:
  - Level Pam$_{min}$
  - Select INT in the menu ANALOG MOD/AM/AM SOURCE INT
  - Modulation depth 30%
  - Modulation frequency 1 kHz
- ➢ Vary the carrier frequency from 5 MHz to RF$_{max}$. For recommended setting values see Table 5-2, at least * frequencies.
- ➢ Read the distortion from the modulation analyzer.
- ➢ Repeat the measurement with Pam$_{max}$ and AM 80%.

5.3.9.3 AM Frequency Response

Test assembly

See section "Test Assemblies", standard test assembly for analog modulations with audio analyzer

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm
  - Select EXT1 in the menu ANALOG MOD/AM/AM SOURCE EXT.
  - Modulation depth 60%
- ➢ Vary the carrier frequency from 5 MHz to RF$_{max}$. For recommended setting values see Table 5-2, at least * frequencies.
- ➢ Setting on audio analyzer:
  - Generator level 1 V (V$_{peak}$).
- ➢ Vary the generator frequency to determine the modulation frequency response.
  - ⇨ The modulation frequency response is the difference between the greatest and the smallest modulation depth.
- ➢ Repeat the measurement with the internal modulation generator with the setting INT in the menu ANALOG MOD/AM/AM SOURCE INT.

5.3.9.4 Residual PhiM with AM

Test assembly

See section "Test Assemblies", standard test assembly for analog modulations

Measurement

➢ Settings on SMIQ:
- Level 0 dBm
- Select INT in the menu ANALOG MOD/AM/AM SOURCE INT.
- Modulation depth 30%
- Modulation frequency 1 kHz

➢ Vary the carrier frequency from 5 MHz to RF_{max}. For recommended setting values see Table 5-2, at least * frequencies.

➢ Measure the resulting phase modulation on the modulation analyzer with a 23 kHz lowpass filter and peak detection.

5.3.9.5 Level Monitoring at Input EXT1

Test assembly

See section "Test Assemblies", standard test assembly for analog modulations with audio analyzer

Test setup

➢ Connect the generator output of the audio analyzer to the external modulation input EXT1.

Measurement

➢ Settings on SMIQ:
- Select EXT1 in the menu ANALOG MOD/AM/AM SOURCE EXT.

⇨ There must be no error message if the input level is correct.

⇨ An error message must be displayed when the deviation attains the value given in the data sheet.

5.3.10 Broadband Amplitude Modulation

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- Signal generator (Table 5-1, item 5)

Test setup

➢ Connect the RF output of the SMIQ to the spectrum analyzer, connect the signal generator to the I (broadband AM) input of the SMIQ.

Measurement

➢ Settings on SMIQ:
- Test level 0 dBm, test frequency > 30.3 MHz
- Select STATE ON in the menu ANALOG MOD/BB-AM.

➢ Setting on signal generator:
- Level 0.25 V (Vpeak) corresponding to -2 dBm

➢ Settings on analyzer:
- Center frequency = test frequency, span 3 MHz to 62 MHz
- Reference level = test level +6 dB
- Scale 2 dB/div

➢ Vary the frequency from 1 MHz to 30 MHz on the signal generator and observe the modulation sidebands on the analyzer using an appropriate span. The modulation depth is determined from the average value of the two sidebands. Since the sidebands have an offset of m/2 from the carrier, an offset of -6 dB corresponds to 100% AM.

⇨ The modulation depth is calculated with the formula $m = 2*10^{(\text{sideband offset}/20)}$.

⇨ The frequency response is the difference between the greatest and the smallest modulation depth.

5.3.11 Pulse Modulation

5.3.11.1 ON/OFF Ratio

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- Pulse generator (Table 5-1, item 17)

Test setup

➢ To determine the ON/OFF ratio, connect the spectrum analyzer to the RF output socket of the SMIQ and the pulse generator to the PULSE socket on the rear of the SMIQ.

Measurement

➢ Setting on SMIQ:
- Select SOURCE EXT in the menu ANALOG MOD/PULSE.

➢ Determine the output level of the SMIQ at various carrier frequencies with a "high" and a "low" signal applied.

⇨ The difference between the output level with a "high" signal applied and that with a "low" signal applied is the ON/OFF ratio.

5.3.11.2 Dynamic Characteristics

Test assembly

See section "Test Assemblies", test assembly for pulse modulation

Measurement

➢ On the dual-trace oscilloscope, simultaneously display the input signal from the pulse generator and the (downconverted) output signal with triggering on the input signal.

➢ Setting on pulse generator:
- Squarewave pulse sequence with a frequency of approx. 100 kHz, TTL level

➢ Setting on SMIQ:
- Pulse modulation, level depending on mixer used

➢ Vary the carrier frequency from 5 MHz to RF_{max}. For recommended setting values see Table 5-2, at least * frequencies.

➢ For carrier frequencies > 50 MHz, use mixer and set an IF of approx. 50 MHz with the auxiliary generator.

➢ Evaluate the pulse-modulated RF signal on the oscilloscope.

⇨ Rise time = time between 10% and 90% of RF amplitude
Fall time = time between 90% and 10% of RF amplitude
Pulse delay = time between 50% of input pulse amplitude and 50% of RF amplitude

5.3.12 Frequency Modulation (Option SM-B5)

5.3.12.1 FM Deviation Setting

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - RF 500 MHz - Level 0 dBm - Select INT in the menu ANALOG MOD/FM/FM1 SOURCE. - Modulation frequency 1 kHz - Deviation 300 Hz to 500 kHz (see below) ➢ Read the FM deviation from the modulation analyzer.
Recommended test deviations	300 Hz ,1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 250 kHz and 500 kHz

5.3.12.2 FM Distortion

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Carrier frequency 500 MHz - Deviation 250 kHz - Level 0 dBm - Select INT in the menu ANALOG MOD/FM/FM1 SOURCE. - Modulation frequency 1 kHz ➢ Read the distortion from the modulation analyzer.

5.3.12.3 FM Frequency Response

FM frequency response up to 100 kHz

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations with audio analyzer

Measurement

- Settings on SMIQ:
  - Test frequency 100 MHz
  - Level 0 dBm
  - Select EXT1 in the menu ANALOG MOD/FM/FM1 SOURCE.
  - Deviation 50 kHz
- Setting on audio analyzer:
  - Generator level 1 V (V_{peak})
- Vary the generator frequency of the audio analyzer from 10 Hz to 100 kHz to determine the modulation frequency response.

  ⇨ The modulation frequency response is the difference between the greatest and the smallest modulation depth.
- Repeat the measurement, applying the signal to socket EXT2 and with the setting ANALOG MOD/FM/FM2 SOURCE EXT2.
- Repeat the measurement with the internal modulation generator and with the setting ANALOG MOD/FM/FM1 SOURCE INT.

Broadband FM frequency response

Test assembly	See section "Test Assemblies", broadband FM

Measurement

- Settings on SMIQ:
  - Select EXT2 in the menu ANALOG MOD/FM/FM2 SOURCE and select deviation according to the table below.
  - Switch the voltmeter to DC measurement.
- Vary the frequency in 10 kHz steps on the SMIQ or the auxiliary generator until the voltmeter indicates 0 V.
- Switch the voltmeter to AC measurement and vary the frequency on the sinewave generator from 10 kHz to maximum frequency.
- Measure the modulation frequency response with the AC voltmeter.

  ⇨ The modulation frequency response is the difference between the greatest and the smallest modulation depth.
- Repeat the measurement, applying the signal to socket EXT1 and with the setting MODULATION/FM/FM1 SOURCE EXT1.

Recommended settings:

F (RF)	50 MHz	750.1 MHz	1099 MHz	1101 MHz	1500 MHz	2200 MHz	3300 MHz	4400 MHz	6400 MHz
Deviation	500 kHz	250 kHz	250 kHz	250 kHz	250 kHz	500 kHz	500 kHz	1000 kHz	1000 kHz
Mixer	no	yes	yes	yes	yes	yes	yes	yes	yes
F (LO)	-	800.1 MHz	1149 MHz	1151 MHz	1550 MHz	2250 MHz	3350 MHz	4450 MHz	6450 MHz

5.3.12.4 FM Preemphasis

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Carrier frequency 100 MHz - Select INT in the menu ANALOG MOD/FM/FM1 SOURCE. - Deviation 25 kHz ➢ With a modulation frequency of 100 Hz, read the deviation from the modulation analyzer and note it down as a reference value. ➢ Switch on preemphasis of 50 μs on the SMIQ and the modulation analyzer and increase the modulation frequency to 15 kHz. ⇨ The difference between the deviation now measured and the reference value is the deviation error with preemphasis. ➢ Repeat the measurement with a preemphasis of 75 μs.

5.3.12.5 Residual AM with FM

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Level 0 dBm - Select INT in the menu MODULATION/FM/FM1 SOURCE. - Deviation 40 kHz - Modulation frequency 1 kHz ➢ Vary the carrier frequency from 5 MHz to RF_{max}. For recommended setting values see Table 5-2, at least * frequencies. ➢ Measure the resulting amplitude modulation on the modulation analyzer with a 23 kHz lowpass filter and peak detection.

5.3.12.6 Carrier Frequency Error with FM

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Frequency 500 MHz - Level 0 dBm - Select INT in the menu ANALOG MOD/FM/FM1 SOURCE. - Deviation 0 kHz ➢ Setting on modulation analyzer - Counter function ➢ Measure the frequency error on switching on the FM. ➢ Increase the deviation to 200 kHz on the SMIQ. ➢ Measure the frequency error with FM with deviation.

5.3.12.7 Level Monitoring at Input EXT2

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations with audio analyzer
Test setup	➢ Connect the generator output of the audio analyzer to the external modulation input EXT2.
Measurement	➢ Same as for AM at input EXT1.

5.3.13 Phase Modulation (Option SM-B5)

Note: As a precondition for these measurements, the measurements described under "Frequency Modulation" must have been successfully concluded.

5.3.13.1 Deviation Setting

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Carrier frequency 1000 MHz - Level 0 dBm - Select INT in the menu ANALOG MOD/PM/PM1 SOURCE. - Modulation frequency 1 kHz - For deviation see below ➢ Read the PhiM deviation from the modulation analyzer.
Recommended test deviations	0.03, 0.1, 0.3, 1, 3, 10 rad

5.3.13.2 PhiM Distortion

Test assembly	See section "Test Assemblies", standard test assembly for analog modulations
Measurement	➢ Settings on SMIQ: - Carrier frequency 1 GHz - Level 0 dBm - Select INT in the menu ANALOG MOD/PM/PM1 SOURCE. - Deviation 5 rad - Modulation frequency 1 kHz ➢ Read the distortion from the modulation analyzer.

5.3.13.3 PhiM Frequency Response

Test assembly

See section "Test Assemblies", standard test assembly for analog modulations with audio analyzer

Measurement

- ➢ Settings on SMIQ:
  - Carrier frequency 1000 MHz
  - Level 0 dBm
  - Select EXT1 in the menu MODULATION/PM/PM1 SOURCE.
  - Deviation 5 rad
- ➢ Setting on audio analyzer:
  - Generator level 1 V (V_{peak})
- ➢ Vary the generator frequency of the analyzer to determine the modulation frequency response.

  ⇨ The modulation frequency response is the difference between the greatest and the smallest modulation depth.
- ➢ For the FMB, it is recommended that the measurement be carried out as frequency modulation measurement as this provides higher accuracy; conversion to phase deviation with m = deviation/f_{mod}. Since no frequency response can occur below 1000 Hz because of the DC coupling, it is sufficient to measure the response starting from 1000 Hz (measurements below 1000 Hz are problematic since deviations are very small).
- ➢ Repeat the measurement with the setting PM2 SOURCE EXT2.
- ➢ Repeat the measurement with the setting PM1 SOURCE INT and variation of the frequency of the internal modulation generator.

5.3.14 Digital Modulation (Option SMIQB20)

5.3.14.1 Deviation Error with FSK

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm, RF 1 GHz
  - Switch on digital modulation 2FSK
  - Symbol rate 1 kHz, deviation 200 Hz
  - Filter GAUSS 0.2
  - Data source PRBS, length 23 bits
- ➢ Make the corresponding settings on the demodulator, evaluation over 150 symbols, 10 averaging procedures
- ➢ Measure the FSK deviation error (rms) on the demodulator.
- ➢ Repeat the measurement with 4FSK, FILTER PARAMETER 0.7.

5.3.14.2 Deviation Error with GFSK

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm, RF 1 GHz
  - Switch on digital modulation GFSK
  - Symbol rate 1300 kHz, deviation 650 kHz
  - Filter GAUSS 0.7
  - Data source PRBS, length 23 bits
- ➢ Make the corresponding settings on the demodulator, evaluation over 150 symbols, 10 averaging procedures
- ➢ Measure the GFSK deviation error (rms) on the demodulator.

5.3.14.3 Phase Error with GMSK

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm, RF 1 GHz
  - Switch on digital modulation GMSK
  - Symbol rate 1000 kHz
  - Filter GAUSS 0.3 and 1 kHz
  - Data source PRBS, length 23 bits
- ➢ Make the corresponding settings on the demodulator, evaluation over 150 symbols, 10 averaging procedures
- ➢ Measure the GMSK phase error (rms) on the demodulator.

5.3.14.4 Error Vector with PSK

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm, RF 1 GHz
  - Switch on digital modulation $\pi/4$ DQPSK
  - Symbol rates 1/18/192/1500 and 3000 kHz
  - Filter SQR COS 0.25/0.35/0.5/0.7
  - Data source PRBS, length 23 bits
- ➢ Make the corresponding settings on the demodulator, evaluation over 150 symbols, 10 averaging procedures
- ➢ Measure the error vector magnitude (rms) on the demodulator for all combinations of the given filters and symbol rates.

5.3.14.5 Error Vector with QAM

Test equipment	Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm, RF 1 GHz
  - Switch on digital modulation 16QAM
  - Symbol rates 1 and 3 MHz
  - Filter SQR COS 0.35
  - Data source PRBS, length 23 bits
- ➢ Make the corresponding settings on the demodulator, evaluation over 150 symbols, 10 averaging procedures
- ➢ Measure the error vector magnitude (rms) on the demodulator for the given symbol rates.

5.3.15 Data Generator (Option SMIQB11)

Test equipment	Storage oscilloscope (Table 5-1, item 3) at the outputs for serial and parallel modulation data, clock and control signals
Test method	To test the data generator, data sequences consisting of modulation data, trigger signals and signals for level control are programmed. The programmed sequences are stored in the data generator memory and are read out cyclically. The correct reproduction of programmed lists can be checked at the corresponding output connectors.

Measurement

- ➢ Settings on SMIQ:
  - Switch on digital modulation 256QAM (8 bits/symbol).
  - Generate new data list with 8 identical bits for each symbol.
  - Select the new data list as data source.
  - Generate and switch on new control list.
  - Symbol rate 1 ksymbol/s
  - Trigger mode AUTO
- ➢ Record the data sequences with an oscilloscope and check whether they correspond to the programmed sequences.
- ➢ Repeat the test for high symbol rates.
  - ⇨ The maximum clock frequency at the data and clock outputs is 7.5 MHz, at the outputs for control and trigger signals up to 1.5 MHz.

5.3.16 Digital Standards (Options)

5.3.16.1 Adjacent-Channel Power Measurement with Higher Resolution

Especially in measurements using the LOW-ACP filter (option SMIQB47), results are influenced by the inherent noise components of the analyzer. The procedure described below allows the measurement limit to be extended beyond that of standard settings.

- The adjacent-channel power measurements are made with the RF analyzer (Table 5-1, item 2) using the CHANNEL POWER marker function.
- To measure the channel power, set the CENTER FREQUENCY to the carrier frequency, SPAN to about twice the symbol rate, POWER MEAS SETTING/CHANNEL BANDWIDTH to about 1.4 times the symbol rate (unless otherwise specified), TRACE/DETECTOR RMS, SWEEP/TIME MANUAL to 1 s, REF LEVEL to approx. 3 to 5 dB below the PEP of the SMIQ, ATTEN AUTO LOW NOISE. Note down the channel power P_{Chan}.
- To measure the adjacent-channel power, detune the CENTER FREQUENCY by the channel spacing, set CHANNEL BANDWIDTH and SPAN (1.4 times the CHANNEL BANDWIDTH) anew if the adjacent-channel power is measured with a different bandwidth. Reduce the REF LEVEL by 20 dB (unless otherwise specified). For some measurements the PLL bandwidth of the FSIQ must be set manually. This is done under COUPLING/MAIN PLL BANDWIDTH. Read the adjacent-channel power ACP. The measurement must be made for both sides (plus and minus the channel spacing); the worse value is the result to be taken.
- In critical cases, the inherent noise of the FSIQ must be determined and subtracted. To this end, press RF OFF on the SMIQ and read the inherent noise power PFSIQ from the FSIQ. If the inherent noise power is below the previously measured power by more than 0.5 dB and less than 10 dB, the adjacent-channel power can be corrected as follows:
- $P_{Corr} = 10 * \log 10(10^{(ACP/10)} - 10^{(PFSIQ/10)})$
- The relative adjacent-channel power in dBc is ACPR $= P_{Chan} - P_{Corr}$.
- If the inherent noise power is less than 0.5 dB below the previously measured power, the power measured is the inherent noise power of the FSIQ; the component contributed by the SMIQ cannot be exactly determined, it is more than 10 dB below the measured value. If the inherent noise power is more than 10 dB below the previously measured power, a correction is not necessary since the noise component of the FSIQ is negligible.

5.3.16.2 GSM

Test equipment	Demodulator for digital modulation with option K11 (Table 5-1, item 23)
Test setup	➢ Connect the demodulator to the RF output of the DUT, connect the output BURST GATE (pin 22 of output PAR DATA, Adapter SMIQ-Z5, recommended) to EXT TRIG GATE on the demodulator.
Measurement	➢ Settings on SMIQ: Level 0 dBm, RF 935.2 MHz Switch on digital standard GMSK ➢ Settings on demodulator: MODE/ GSM BTS analyzer SETTINGS/ EXTERNAL ATTENUATOR 46 dB POWER VS TIME CONTINUOUS FULL BURST ➢ LIMIT CHECK : PASSED should be displayed on the demodulator. ➢ Set demodulator to: PHASE/FREQUENCY ERROR SINGLE NO. OF BURSTS/ SET TO STANDARD ➢ The status PASSED should be indicated; check phase errors (peak and rms) for compliance with data sheet tolerances. ➢ Set demodulator to: TRANSIENT SPECTRUM/ CONTINUOUS FREQ SWEEP ➢ LIMIT CHECK : PASSED should be displayed on the demodulator.

5.3.16.3 DECT

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  - Level 0 dBm, RF 1880 MHz
  - Switch on digital standard DECT.

- ➢ Make the corresponding settings on the demodulator.
  Measure the DECT deviation error (rms) with the setting SYMB TABLE / ERRORS.

- ➢ To measure the burst on/off ratio, operate the demodulator as a spectrum analyzer.
  Settings:
  SPAN 0 Hz
  RES BW 2 MHz
  TRACE1 AVERAGE
  TRIGGER/ VIDEO –40 dBm, SLOPE POS
  SWEEP TIME MANUAL 1 ms

- ➢ SLOT 0 should be displayed on the analyzer. Read the level in SLOT 0 and note it down.

- ➢ On the DUT, set the SLOT LEVEL in SLOT 0 to OFF.
  All slots must now be switched off.

- ➢ Switch on TRIGGER/ FREE RUN on the analyzer.
  REF LEVEL –30 dBm and
  RF ATTEN MANUAL 0 dB

- ➢ Read the (blanked) level. With RF OFF on the DUT, the spacing to the analyzer's noise floor can be determined. If the spacing is less than 10 dB and more than 1 dB, the noise floor can be deducted. With less than 1 dB, the analyzer resolution is insufficient; the true measurement result is better by at least 6 dB. With more than 10 dB, correction is not necessary.

- ➢ The burst on/off ratio is the difference between the two levels in dB.

5.3.16.4 NADC

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- Settings on SMIQ:
  Level 0 dBm, RF 824/894/1900 MHz
  Switch on digital standard NADC DOWNLINK.
  Select FILTER MODE LOW_EVM for error vector measurement and LOW_ACP for ACP measurement.
- Select standard NADC FWD CH on the demodulator and also make the other corresponding settings.
  Under SYMB TABLE / ERRORS, read the error vector magnitude (rms) for the RF frequencies given above.
- Adjacent-channel power measurement is implemented as standard in the FSIQ.
  - LEVEL REF -5 dBm
  - ATTEN AUTO LOW NOISE
  - MARKER/ POWER MEAS SETTINGS:
    - SET NO. OF ADJ CHANNELS 3
    - Select ACP STANDARD NADC.
  - MARKER/ ADJACENT CHANNEL POWER
  - MARKER/ ADJUST CP SETTINGS
  - In addition, set the PLL bandwidth to MEDIUM in the menu COUPLING and select RMS in TRACE/DETECTOR (after ADJUST CP SETTINGS) and a sweep time of 2 s.

Note: *Especially the values at 90 kHz offset strongly depend on the analyzer resolution (parameter spread). If necessary, use the procedure described in section "Adjacent-Channel Power Measurement with Higher Resolution" above to perform the measurement.*

5.3.16.5 PDC

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- Settings on SMIQ:
  Level 0 dBm, RF 810/956/1501 MHz
  Switch on digital standard PDC DOWNLINK.
  Select FILTER MODE LOW_EVM for error vector measurement and LOW_ACP for ACP measurement.
- Select LEVEL REF 5 dBm and standard PDC DOWN on the demodulator and also make the other corresponding settings.
  Under SYMB TABLE / ERRORS, read the error vector magnitude (rms) for the RF frequencies given above.
- Adjacent-channel power measurement is implemented as standard in the FSE, in addition the PLL bandwidth must be set to MEDIUM in the menu COUPLING.

Note: *Especially the values at 100 kHz offset strongly depend on the analyzer resolution (parameter spread). If necessary, use the procedure described in section "Adjacent-Channel Power Measurement with Higher Resolution" above to perform the measurement.*

5.3.16.6 PHS

Test equipment	Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:
  Level 0 dBm, RF 1900 MHz
  Switch on digital standard PHS.
  Select FILTER MODE LOW_EVM for error vector measurement and LOW_ACP for ACP measurement.
- ➢ Select LEVEL REF 5 dBm and standard PHS on the demodulator and also make the other corresponding settings.
  Under SYMB TABLE / ERRORS, read the error vector magnitude (rms).
- ➢ Setting on SMIQ:
  DIGITAL MOD/SELECT STANDARD PHS
- ➢ Set LEVEL REF –5 dBm ATTEN AUTO LOW NOISE on the demodulator.
  Adjacent-channel power measurement is implemented as standard in the FSE.
  Set POWER MEAS SETTINGS/ NO. OF CHANNELS to 3.
- ➢ Pressing ALT1 furnishes the value for a 600 kHz offset, ALT2 for a 900 kHz offset.

Note: *Especially the values at 900 kHz offset strongly depend on the analyzer resolution (parameter spread). If necessary, use the procedure described in section "Adjacent-Channel Power Measurement with Higher Resolution" above to perform the measurement.*

5.3.17 IS-95 CDMA (Option SMIQB42)

Rho factor

Test equipment	Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- ➢ Settings on SMIQ:

1st measurement
- Level 0 dBm, RF 824/894/1900 MHz
- Switch on digital modulation IS95 CDMA.
- Select MODE FWD_LINK_18.
- Select filter mode LOW_EVM.
- Switch off all code channels except pilot.
- Set power for pilot channel to 0 dB.

2nd measurement
- Select MODE REV_LINK, full rate, data 0000.

- ➢ Settings on demodulator:

1st measurement: select DIGITAL STANDARDS QCDMA FWD.
2nd measurement: select QCDMA REV CH.
- Evaluation over 600 symbols

Adjacent-channel power

Test equipment

RF spectrum analyzer (Table 5-1, item 2)

Test setup

Connect the spectrum analyzer to the RF output of the SMIQ.

Measurement

➢ Settings on SMIQ:
1. Reverse Link
- DIG STD IS95
- MODE REV_LINK
- IQ FILTER 850 kHz
- DATA PRBS
- Level (PEP) 0.2 and -0.2 dBm

2. Forward Link 9Chan
- Switch on DIG STD IS95.
- Select MODE FWD_LINK_18.
- SAVE/RCL MAPPING, GET PREDEFINED MAPPING, 09CHAN
- IQ FILTER 850 kHz
- Level (PEP) 0.2 and -0.2 dBm

- RF 824/894/1850/2000 MHz

➢ Setting on spectrum analyzer
- LEVEL REF –5 dBm

➢ Test procedure
Same as described in section "Adjacent-Channel Power Measurement with Higher Resolution" above, channel bandwidth 1.2288 MHz, adjacent-channel bandwidth 30 kHz, channel spacings 885 kHz, 1.25 MHz, 1.98 MHz.

5.3.18 W-CDMA (Option SMIQB43)

Error vector

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Measurement

➢ Settings on SMIQ:

- Level -10 dBm
- RF 1800/2000/2200 MHz
- Select digital standard W-CDMA with the following settings:
  - SET DEFAULT
  - MODE 4CHAN
  - CHIP RATE 4.096 M
  - LINK DIR DOWN
  - SEQUENCE LENGTH 10 frames
  - MODULATION FILTER MODE LOW_EVM
  - CHNO 0 TYPE DPCH, SYMBOL RATE 32, SHO CO 9, POWER 0, DATA PN9, TPC ALT
  - Switch the other channels off (STATE OFF).

➢ Settings on demodulator:
- REF LEVEL –5 dBm
- DIGITAL STANDARDS W-CDMA FWD CH
- Evaluation over 600 symbols

Adjacent-channel power

Test equipment	RF spectrum analyzer (Table 5-1, item 2)

Measurement

- ➢ Settings on SMIQ:
  - Level (PEP) 0.2 and -0.2 dBm
  - RF 1800/2000/2200 MHz
  - Select digital standard W-CDMA with the following settings:
    - SET DEFAULT
    - MODE 4CHAN
    - LINK DIR DOWN
    - SEQUENCE LENGTH 10 frames
    - MODULATION FILTER MODE LOW_ACP
    - CHNO 1 TYPE DPCH, SYMBOL RATE 32, SHO CO 9, POWER 0, DATA PN 9, TPC ALT
    - Switch the other channels off (STATE OFF).
- ➢ Settings on spectrum analyzer:
  - LEVEL REF -10 dBm
  - Determine the channel power and the adjacent-channel power at a bandwidth of 4.096 MHz and spacings of 5 MHz and 10 MHz in accordance with section "Adjacent-Channel Power Measurement with Higher Resolution" above.

5.3.19 3 GPP W-CDMA (Options SMIQB20 and SMIQB45)

5.3.19.1 Bit Error Rate Test

The interface is tested via an adapter at the BER connector (rear panel). By means of the adapter the inputs and outputs of the interface are connected and the functions tested. The adapter should be a 9-pin female D-SUB connector. Pin 6 is connected to pin 8, and pin 7 to pin 9.

Measurement

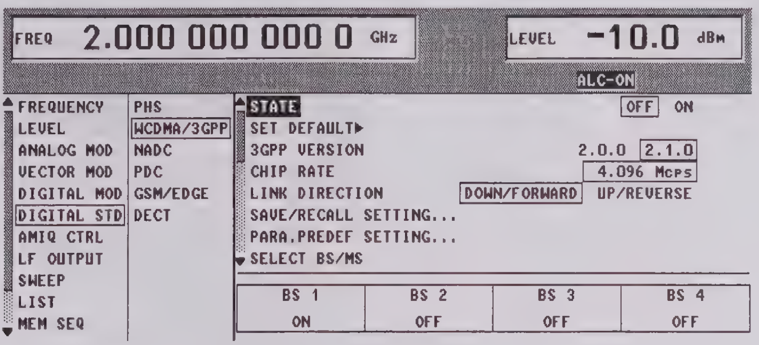
- ➢ Settings on SMIQ
  - UTILITIES/TEST/TEST MCOD BERT
- ➢ Error messages may not occur during the test.

5.3.19.2 3 GPP W-CDMA with 1 Code Channel

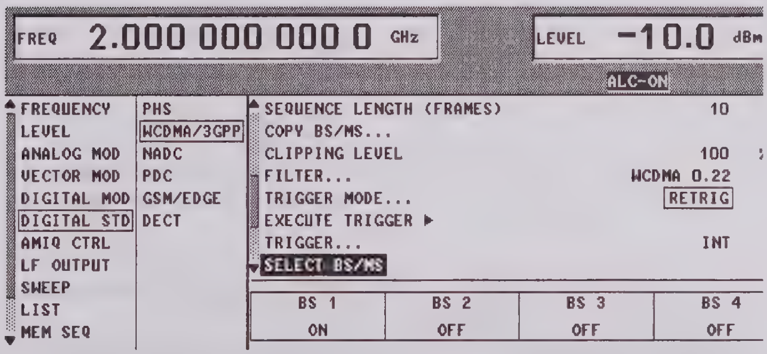
Test equipment	RF spectrum analyzer (Table 5-1, item 2)

Measurement

- ➢ General settings on SMIQ
  - Level (PEP) 0.2 and –0.2 dBm
  - RF 1800, 2000 and 2200 MHz
- ➢ Modulation settings on SMIQ:
  - SET DEFAULT
  - 3GPP VERSION 2.1.0
  - CHIP RATE 4.096 M
  - LINK DIRECTION DOWN/FORWARD
  - SEQUENCE LENGTH 10
  - CLIPPING LEVEL 100%
  - FILTER WCDMA 0.22

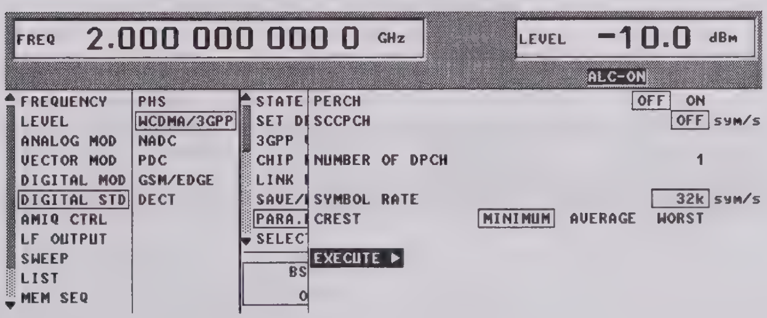


FREQ 2.000 000 000 0 GHz
LEVEL -10.0 dBm
STATE OFF ON
3GPP VERSION 2.0.0 2.1.0
CHIP RATE 4.096 Mcps
LINK DIRECTION DOWN/FORWARD UP/REVERSE
BS 1 ON
BS 2 OFF
BS 3 OFF
BS 4 OFF



FREQ 2.000 000 000 0 GHz
LEVEL -10.0 dBm
SEQUENCE LENGTH (FRAMES) 10
CLIPPING LEVEL 100
FILTER... WCDMA 0.22
TRIGGER MODE... RETRIG
TRIGGER... INT
BS 1 ON
BS 2 OFF
BS 3 OFF
BS 4 OFF

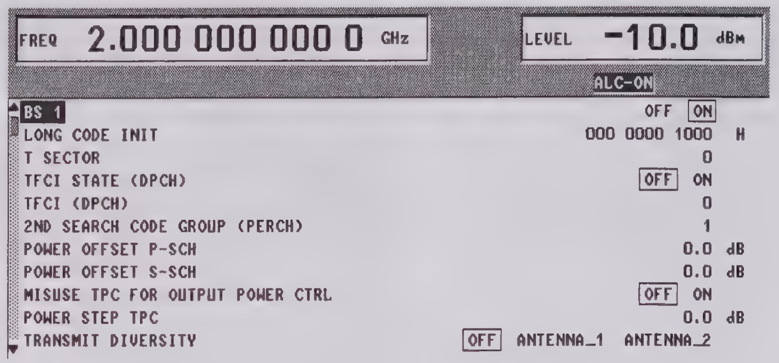
- ➢ Menu **PARA. PREDEF** (all parameters and channel tables of the base station are automatically set)
  - PERCH OFF
  - SCCPCH OFF
  - NUMBER OF DPCH 1
  - SYMBOL RATE 32 ksym/s
  - CREST MINIMUM
  - EXECUTE



FREQ 2.000 000 000 0 GHz
LEVEL -10.0 dBm
PERCH OFF ON
SCCPCH OFF sym/s
NUMBER OF DPCH 1
SYMBOL RATE 32k sym/s
CREST MINIMUM AVERAGE WORST

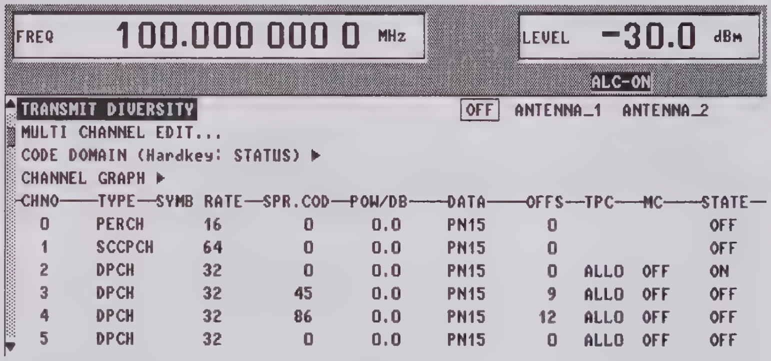
- ➢ The following settings result from this selection:
  - BS 1 ON, all other channels BS OFF

- ➢ Menu Select BS/MS: BS1



```
FREQ  2.000 000 000 0 GHz                LEVEL  -10.0 dBm
                                                ALC-ON
BS 1                                               OFF  ON
LONG CODE INIT                             000 0000 1000  H
T SECTOR                                                 0
TFCI STATE (DPCH)                                  OFF  ON
TFCI (DPCH)                                              0
2ND SEARCH CODE GROUP (PERCH)                            1
POWER OFFSET P-SCH                                  0.0 dB
POWER OFFSET S-SCH                                  0.0 dB
MISUSE TPC FOR OUTPUT POWER CTRL                   OFF  ON
POWER STEP TPC                                      0.0 dB
TRANSMIT DIVERSITY              OFF  ANTENNA_1  ANTENNA_2
```

- ➢ Channel table:
  - - CHNO 2
  - - TYPE DPCH
  - - SYMB RATE 32k
  - - SPREAD. CODE 0
  - - POWER 0 dB
  - - DATA PN 15
  - - OFFS 0
  - - TPC ALL0
  - - MC STATE OFF, STATE ON
- ➢ All other channels: STATE OFF



```
FREQ  100.000 000 0 MHz                  LEVEL  -30.0 dBm
                                                ALC-ON
TRANSMIT DIVERSITY              OFF  ANTENNA_1  ANTENNA_2
MULTI CHANNEL EDIT...
CODE DOMAIN (Hardkey: STATUS) ▶
CHANNEL GRAPH ▶
CHNO---TYPE--SYMB RATE--SPR.COD--POW/DB---DATA---OFFS--TPC---MC----STATE-
  0    PERCH     16         0      0.0    PN15     0                OFF
  1    SCCPCH    64         0      0.0    PN15     0                OFF
  2    DPCH      32         0      0.0    PN15     0   ALLO  OFF    ON
  3    DPCH      32        45      0.0    PN15     9   ALLO  OFF    OFF
  4    DPCH      32        86      0.0    PN15    12   ALLO  OFF    OFF
  5    DPCH      32         0      0.0    PN15     0   ALLO  OFF    OFF
```

- ➢ Settings on demodulator for error vector measurements
  - - REF LEVEL –5 dBm
  - - DIGITAL STANDARDS W-CDMA FWD CH
  - – Evaluation over 600 symbols
- ➢ Measure EVM (observe data in data sheet), filter mode LOW_EVM, for SMIQB47 without and with filter 2.5 MHz.
- ➢ Measure adjacent-channel power (ACPR) (cf. corresponding section), filter mode LOW_ACP, bandwith of channel and adjacent channel 4.096 MHz, for SMIQB47 without and with filter 2.5 MHz.

5.3.19.3 3GPP W-CDMA with 8 Code Channels

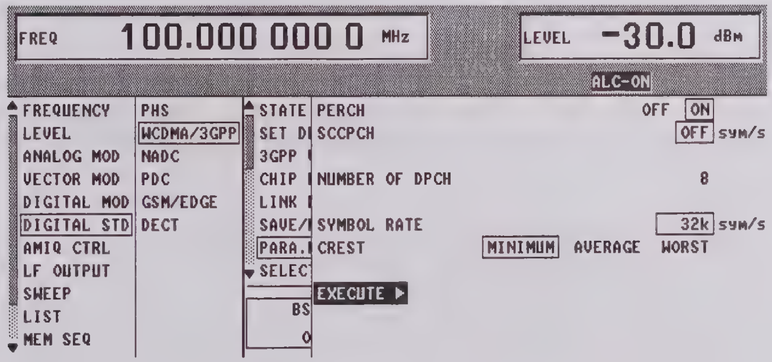
Test equipment RF spectrum analyzer (Table 5-1, item 2)

Measurement

➢ General settings on SMIQ
- Level (PEP) 0.2 and -0.2 dBm
- RF 1800, 2000 and 2200 MHz

➢ Modulation settings on SMIQ:
- SET DEFAULT
- 3GPP VERSION 2.1.0
- CHIP RATE 4.096 M
- LINK DIRECTION DOWN/FORWARD
- SEQUENCE LENGTH 10
- CLIPPING LEVEL 100%
- FILTER WCDMA 0.22, same as 3GPP W-CDMA with 1 code channel

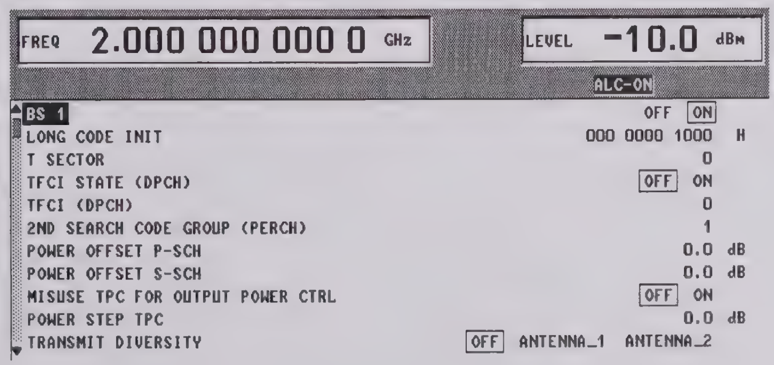
➢ Menu **PARA. PREDEF** (all parameters and channel tables of the base station are automatically set)
- PERCH OFF
- SCCPCH OFF
- NUMBER OF DPCH 8
- SYMBOL RATE 32 ksym/s
- CREST MINIMUM
- EXECUTE



PERCH OFF ON
SCCPCH OFF sym/s
NUMBER OF DPCH 8
SYMBOL RATE 32k sym/s
CREST MINIMUM AVERAGE WORST

➢ The following settings result from this selection:
- BS 1 ON, all other channels BS OFF

➢ Menu Select BS/MS: BS1

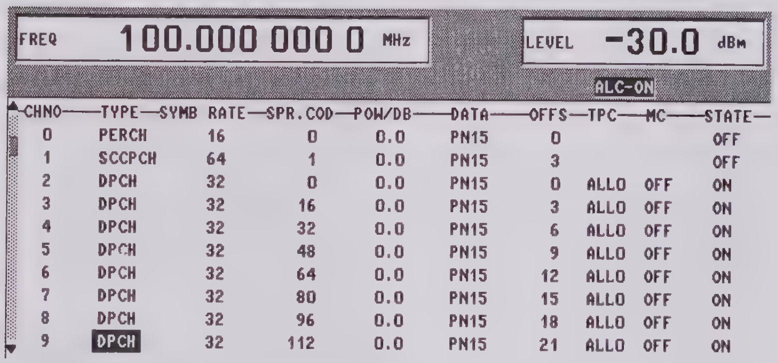


BS 1 OFF ON
LONG CODE INIT 000 0000 1000 H
T SECTOR 0
TFCI STATE (DPCH) OFF ON
TFCI (DPCH) 0
2ND SEARCH CODE GROUP (PERCH) 1
POWER OFFSET P-SCH 0.0 dB
POWER OFFSET S-SCH 0.0 dB
MISUSE TPC FOR OUTPUT POWER CTRL OFF ON
POWER STEP TPC 0.0 dB
TRANSMIT DIVERSITY OFF ANTENNA_1 ANTENNA_2

- Channel table: CHNO 2 to 9:

CHNO	SPREAD. CODE	OFFS	Common parameter
2	0	0	TYPE DPCH SYMB RATE 32k POWER 0 dB, DATA PN 15 TPC ALL0 MC STATE OFF STATE ON
3	16	3	
4	32	6	
5	48	9	
6	64	12	
7	80	15	
8	96	18	
9	112	21	

- All other channels: STATE OFF



```
FREQ      100.000 000 0 MHz          LEVEL   -30.0 dBm
                                             ALC-ON
CHNO——TYPE—SYMB RATE—SPR.COD—POW/DB——DATA——OFFS—TPC——MC——STATE—
 0    PERCH     16        0     0.0    PN15     0                OFF
 1    SCCPCH    64        1     0.0    PN15     3                OFF
 2    DPCH      32        0     0.0    PN15     0   ALLO  OFF    ON
 3    DPCH      32       16     0.0    PN15     3   ALLO  OFF    ON
 4    DPCH      32       32     0.0    PN15     6   ALLO  OFF    ON
 5    DPCH      32       48     0.0    PN15     9   ALLO  OFF    ON
 6    DPCH      32       64     0.0    PN15    12   ALLO  OFF    ON
 7    DPCH      32       80     0.0    PN15    15   ALLO  OFF    ON
 8    DPCH      32       96     0.0    PN15    18   ALLO  OFF    ON
 9    DPCH      32      112     0.0    PN15    21   ALLO  OFF    ON
```

- Measure adjacent-channel power (ACPR) (cf. corresponding section), filter mode LOW_ACP, bandwith of channel and adjacent channel 4.096 MHz, for SMIQB47 without and with filter 2.5 MHz.

5.3.20 Fading Simulation (Option SMIQB14/SMIQB15)

5.3.20.1 Frequency Response

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- Signal generator (Table 5-1, item 5)

Test setup

➢ Connect the RF output of the SMIQ to the spectrum analyzer and connect the signal generator to the I input of the SMIQ.

Test method

By applying a sinusoidal AC voltage to the I input, an amplitude modulation with suppressed carrier is generated. The fading simulator is set so that a copy of the input signal only slightly shifted in frequency is generated at its output. The amplitude modulation is maintained. The modulation frequency response is determined by measuring the sidebands as a function of the frequency of the AC voltage applied.

Measurement

➢ Settings on SMIQ:
- Test level –10 dBm, test frequency > 15 MHz
- Switch on vector modulation
- Switch on fading simulation
- Path 1 with PURE DOPPLER, 0 dB, Doppler frequency 1 Hz
- Other paths are switched off

➢ Setting on signal generator:
- Level 0.5 V (Vpeak) corresponding to 4 dBm

➢ Settings on analyzer:
- Center frequency = test frequency,
  span = 3 times the sideband frequency
- Reference level = test level
- Scale 1dB/div

➢ Vary the frequency from 0.3 MHz to 10 MHz on the signal generator and observe the modulation sidebands on the analyzer.

➢ For evaluation, determine the difference between the modulation sidebands and the first sideband at 0.3 MHz. The values of the left and the right sideband have to be averaged.

⇨ The modulation frequency response is the level difference between the highest and the lowest sideband.

5.3.20.2 Level Error

Test assembly

Test assembly with spectrum analyzer for fading simulation

Test method

For vector modulation, a single-sideband amplitude modulation (SSB-AM) is generated by applying a sinusoidal signal to the I input and a cosine signal to the Q input. The effect of the fading simulator on level accuracy is determined by two measurements with the fading simulator switched on and off.

Measurement

➢ Settings on SMIQ:
- Test level –10 dBm, test frequency 1 GHz
- Switch on vector modulation
- Switch on fading simulation
- Path 1 with PURE DOPPLER, 0 dB
- Doppler frequency 1 kHz, frequ. ratio +1
- Other paths are switched off

➢ Settings on ARB generator:
- Level 0.5 V (Vpeak)
- Channel 1 sinusoidal signal 10 kHz
- Channel 2 cosine signal (90° phase rel. to channel 1), 10 kHz

➢ Settings on spectrum analyzer:
- Center frequency = test frequency, span 50 kHz
- Reference level = test level
- Scale 5 dB/div

➢ Measure the level of the SSB-AM spectral line at 11 kHz from the carrier. Switch off the fading simulation and measure the level of the SSB-AM spectral line at 10 kHz from the carrier.

➢ For evaluation determine the difference between the measured levels.

⇨ The result is the level error caused by the fading simulator.

5.3.20.3 Path Attenuation

Test assembly

Test assembly with spectrum analyzer for fading simulation

Test method

For vector modulation, a single-sideband amplitude modulation (SSB-AM) is generated by applying a sinusoidal signal to the I input and a cosine signal to the Q input. The second sideband and the carrier are suppressed.

The fading simulator is set so that only a single transmission path with a constant amplitude is available. The attenuation of this path is determined for different settings of the path attenuation by measuring the output level of the SSB-AM.

Measurement

- ➢ Settings on SMIQ:
  - Test level -10 dBm, test frequency 1 GHz
  - Switch on vector modulation
  - Switch on fading simulation
  - Path 1 with PURE DOPPLER, 0 dB
  - Doppler frequency 1 kHz, frequ. ratio +1
  - Other paths are switched off
- ➢ Settings on ARB generator:
  - Level 0.5 V (Vpeak)
  - Channel 1 sinusoidal signal 10 kHz
  - Channel 2 cosine signal (90° phase rel. to channel 1), 10 kHz
- ➢ Settings on spectrum analyzer:
  - Center frequency = test frequency + 11 kHz, span 0
  - Resolution bandwidth 1 kHz, video bandwidth 100 Hz
  - Reference level = test level
  - Scale 2 dB/div
- ➢ Vary the path attenuation on the SMIQ from 0 dB to 20 dB in steps of 2 dB and measure the level on the spectrum analyzer for each setting.
  - ⇨ The measurement at 0 dB is the reference measurement. The difference between the measured attenuation (relative to the reference measurement) and the set path attenuation is evaluated.

5.3.20.4 Path Delay

Preliminary remark

Since the delay between various paths of the fading simulator is implemented fully digitally, a test is not necessarily required. The required setting accuracy is guaranteed by the digital hardware and software design.

Test assembly

Test assembly with sampling oscilloscope for fading simulation connected to the outputs I-FADED and Q-FADED. For accurate checking of compliance with data sheet specifications, the oscilloscope must have a sampling rate of at least 500 Msamples/s.

Test method

With vector modulation and fading simulation switched on, a periodic pulse signal with short pulses is applied to the I input of the SMIQ.

The fading simulator is set so that two transmission paths with different delays are available. As a result, two echoes of the pulse signal are obtained. The accuracy of the set path delay is checked by measuring the delay between the echoes at the output of the fading simulators.

Measurement

- Settings on SMIQ:
  - Test level –10 dBm
  - Switch on vector modulation
  - Switch on fading simulation
  - Path 1 with PURE DOPPLER, 0 dB, 0 µs, frequ. ratio 0
  - Path 2 with PURE DOPPLER, 0 dB, 1 µs, frequ. ratio 0
  - Other paths are switched off
- Settings on ARB generator:
  - Level 0.5 V (Vpeak)
  - Channel 1 pulse signal with 100 ns switch-on time, 2.6 µs switch-off time
- Setting on sampling oscilloscope
  - Time interval 2 µs
- Measure the time difference between the two pulse signals at the I or Q output of the fading simulator using the oscilloscope.

  ⇨ The measured time difference (rising edge) must be equal to the difference between the set path delays.

5.3.20.5 Doppler Shift

Test equipment

Frequency counter (Table 5-1, item 1)

Test setup

- Connect the frequency counter to the RF output of the SMIQ.

Test method

For vector modulation, a single-sideband amplitude modulation (SSB-AM) is generated by applying a sinusoidal signal to the I input and a cosine signal to the Q input. The second sideband and the carrier are suppressed.

The fading simulator is set so that only a single transmission path with a constant amplitude is available. With a Doppler shift set, the output frequency is shifted by the set Doppler frequency. The accuracy of the setting is checked by measuring the output frequency for various settings of the Doppler frequency.

Measurement

- Settings on SMIQ:
  - Test level –10 dBm, test frequency 1GHz
  - Switch on vector modulation
  - Switch on fading simulation
  - Path 1 with PURE DOPPLER, 0 dB
  - Doppler frequencies 0.1/0.2/0.5/1 kHz
  - Other paths are switched off
- Settings on ARB generator:
  - Level 0.5 V (Vpeak)
  - Channel 1 sinusoidal signal 10 kHz
  - Channel 2 cosine signal (90° phase rel. to channel 1), 10 kHz
- Measure the output frequency by means of the frequency counter.

  ⇨The measured frequency differences must correspond to the differences of the set Doppler frequency values.

5.3.21 Noise Generation and Distortion Simulation (Option SMIQB17)

5.3.21.1 Bandwidth and Frequency Response through to RF Output

Test equipment

- Spectrum analyzer (Table 5-1, item 2)
- Signal generator (Table 5-1, item 5)

Test setup

- ➢ Connect the RF output of the SMIQ to the spectrum analyzer and connect the signal generator to the I input of the SMIQ.
- ➢ Terminate the Q input with 50 Ω.

Test method

By applying a sinusoidal AC voltage to the I input, an amplitude modulation with suppressed carrier is generated. The RF frequency response is determined by measuring the sidebands as a function of the frequency of the AC voltage applied.

Measurement

- ➢ Settings on SMIQ:
  - Test level 0 dBm
  - Test frequency 1.472 GHz and frequencies according to Table 5-2
  - Switch on vector modulation
  - Switch on DISTORTION CHARACTERISTIC TEST
- ➢ Setting on signal generator:
  - Level 0.5 V (Vpeak) corresponding to 4 dBm
- ➢ Settings on analyzer:
  - Center frequency = test frequency, span = 3 times the modulation frequency
  - Reference level = test level
  - Scale 1 dB/div
- ➢ Vary the frequency from 0.1 MHz to 7 MHz on the signal generator and observe the modulation sidebands on the analyzer.
  - ⇨ The additional frequency response is the level difference between the highest and the lowest sideband.

Test setup

- ➢ Connect the signal generator to the Q input of the SMIQ.
- ➢ Terminate the I input with 50 Ω.

Measurement

- ➢ Same as for I input above.

5.3.21.2 Residual Carrier

Test equipment

Spectrum analyzer (Table 5-1, item 2)

Test setup

- ➢ Connect the spectrum analyzer to the RF output of the SMIQ.
- ➢ Terminate the I and the Q input with 50 Ω.

Measurement

- ➢ Settings on SMIQ:
  - Test level 0 dBm
  - Test frequency 1.472 GHz and frequencies according to Table 5-2
  - DISTORTION CHARACTERISTIC LIST
    Switch on SELECT LIST...TEST,
    DISTORTION ON
  - Select OFF in the menu VECTOR MOD/STATE
- ➢ Settings on analyzer:
  - Center frequency = test frequency, span = 1 MHz
  - Reference level = test level
  - Scale 10 dB/div
- ➢ First measure the unmodulated level as a reference.
- ➢ Switch on vector modulation (STATE ON) and measure the residual carrier.

  ⇨ The residual carrier in dBc is the level of the residual signal found referred to the output signal of the DUT without modulation (dBc = referred to the carrier). This value must be about the typical value (<-35 dBc) to ensure that the C/N values are maintained.

5.3.21.3 Frequency Response through to I-FADED, Q-FADED Outputs

Test equipment	- Spectrum analyzer (Table 5-1, item 2) - Signal generator (Table 5-1, item 5)
Test setup	➢ Connect the signal generator to the I input of the SMIQ. Connect the I-FADED output on the rear panel of the SMIQ to the spectrum analyzer. ➢ Terminate the Q input with 50 Ω.
Test method	By applying a sinusoidal AC voltage to the I input, a sinusoidal signal will be obtained at the I-FADED output whose level can be measured with the spectrum analyzer.
Measurement	➢ Settings on SMIQ: - Switch on vector modulation - Switch on DISTORTION CHARACTERISTIC TEST ➢ Setting on signal generator: - Level 0.5 V (Vpeak) corresponding to 4 dBm ➢ Settings on analyzer: - Start frequency = 0 MHz - Stop frequency = 5 MHz ➢ Vary the frequency from 0.1 MHz to 5 MHz on the signal generator and measure the level. ⇨ The frequency response is the difference between the highest and the lowest level.
Test setup	➢ Connect the Q-FADED output on the rear panel of the SMIQ to the spectrum analyzer, connect the signal generator to the Q input of the SMIQ. ➢ Terminate the I input with 50 Ω.
Measurement	Same as for I input above.

5.3.21.4 Carrier/Noise Ratio

Test equipment

Demodulator for digital modulation (Table 5-1, item 23)

Test setup

➢ Connect the demodulator to the RF output of the SMIQ.

Test method

The carrier signal (C) and the noise signal (N) are superimposed on each other. So, a new menu (:UTILITIES:DIAG:CN/MEAS) has been introduced which allows either the carrier signal or the noise signal to be switched on alone.

To determine the carrier/noise ratio, the noise power N is measured by integrating the power density over the system bandwidth with the noise switched on alone, and the carrier power C is measured by integrating the power density over the channel bandwidth with the carrier switched on alone.

Integration is performed by means of the RF analyzer (Table 5-1, item 2), using the CHANNEL POWER marker function and with the rms detector switched on.

From C[dBm] and N[dBm], the carrier/noise ratio
C/N[dB] = C[dBm] - N[dBm] is obtained.

Measurement

➢ Settings on SMIQ:
- Test frequency 1 GHz
- Switch on digital modulation QPSK
- Symbol rate 300 k
- Switch on noise with C/N = -30 dB / -5 dB / 4 dB / 20 dB and SYSTEM BANDWITH = 500 kHz
- Test level 0 dBm (PEP)

➢ Settings on demodulator:
- REF LEVEL = test level
- Span = 600 kHz
- MARKER NORMAL / CHANNEL POWER
- CHANNEL BANDWIDTH 500kHz

➢ Then set `:UTILITIES:DIAG:CN/MEAS CARRIER` on the SMIQ.

➢ Integration of carrier power C[dBm] over 500 kHz with rms detector, SWEEP TIME 2 s

➢ Set `:UTILITIES:DIAG:CN/MEAS NOISE` on the SMIQ.

➢ Integration of noise power N[dBm] over 500 kHz

The C/N ratio in dBc is the level of the measured noise power referred to the level of the carrier signal.

5.3.21.5 Carrier/Noise Ratio, WorldSpace

Test equipment
Same as above

Test setup
Same as above

Test method
Same as above

Measurement

- Settings on SMIQ:
  - Test level -15 dBm
  - Test frequency 1.472 GHz
  - Switch on digital modulation standard WORLDSPACE
  - Switch on filter mode LOW_EVM.
  - Data source PRBS
  - Switch on noise with C/N = -5 dB / 4 dB / 20 dB and SYSTEM BANDWITH = 1.84 MHz
- Settings on demodulator
  Same as above but with:
  - Span = 3.68 MHz
  - CHANNEL BANDWIDTH 2.576 MHz
- Then set `:UTILITIES:DIAG:CN/MEAS CARRIER` on the SMIQ.
- Integration of carrier power C[dBm] over 2.576 MHz with rms detector, SWEEP TIME 2 s
- Set `:UTILITIES:DIAG:CN/MEAS NOISE` on the SMIQ.
- Set CHANNEL BANDWIDTH 1.84 MHz for integration of noise power N[dBm] over 1.84 MHz
- Repeat all measurements with active DISTORTION CHARACTERISTIC TWTA.

5.3.21.6 Error Vector

Test equipment
Demodulator for digital modulation (Table 5-1, item 23)

Measurement

- Settings on SMIQ:
  - Test level Pvm_{max} (PEP)
  - Test frequency 1.472 GHz and frequencies according to Table 5-2
  - Switch on digital modulation standard WORLDSPACE
  - Switch on filter mode LOW_EVM
  - Data source PRBS
  - Switch on DISTORTION CHARACTERISTIC TEST
- Settings on demodulator:
  - QPSK modulation
  - Symbol rate = 1.84 Msym/s
  - Filter: SQR COS 0.4
  - Reference level = Pvm_{max} + 3 dBm
  - Evaluation over 150 symbols
  - 10 averaging procedures
- Measure the error vector magnitude (rms) on the demodulator.

5.3.21.7 Noise Frequency Response

Test equipment

Spectrum analyzer (Table 5-1, item 2)

Test setup

- ➢ Connect the spectrum analyzer to the RF output of the SMIQ.
- ➢ Terminate the I and the Q input with 50 Ω.

Measurement

- ➢ Settings on SMIQ:
  - - Test level -10 dBm
  - - Test frequency 1.472 GHz
  - - Set Noise/Disto CARRIER/NOISE RATIO 4 dB and SYSTEM BANDWITH 1.84 MHz
  - - Select ON in the menu VECTOR MOD/STATE
- ➢ Settings on analyzer:
  - - Center frequency = test frequency, span = 5 MHz
  - - Reference level = -25 dBm
  - - Scale 1 dB/div
  - - RBW 100 kHz, VBW 5 Hz
- ➢ Measure the frequency response of the noise signal between the test frequency -1290 kHz and the test frequency +1290 kHz.
- ➢ Setting on SMIQ:
  - - Set Noise/Disto SYSTEM BANDWITH 10 MHz
- ➢ Settings on analyzer:
  - - Center frequency = test frequency, span 20 MHz
  - - RBW 500 kHz, VBW 5 Hz
- ➢ Measure the frequency response of the noise signal between the test frequency -5000 kHz and the test frequency +5000 kHz.

5.4 Performance Test Report

ROHDE&SCHWARZ	**SIGNAL GENERATOR** **SMIQ02B/03B/04B/06B**	**1125.5555.02/03/04/06**

Serial number:

Person testing:

Date:

Signature:

For nominal data and limit values refer to the data sheet supplied with the instrument.

Section	Characteristic	**Min.**	**Actual**	**Max.**	**Unit**
5.3.1	Display and keyboard	O.K.			-
5.3.2.1	Frequency setting	O.K.			-
5.3.2.2	Setting time CW VM, ALC TABLE				ms ms
5.3.3	Reference frequency, drift, input for external reference	O.K.			Hz -
5.3.4.1	Frequency response at 0 dBm with ALC OFF Level, total error for RF <= 2 GHz RF > 2 GHz				dB dB dB dB
5.3.4.2	Output impedance (VSWR) at max. level, lower frequency range at max. level, upper frequency range at low level, lower frequency range at low level, upper frequency range				- - - -
5.3.4.3	Setting time (IEC/IEEE bus) CW, analog modulation, with mechanical attenuator without mechanical attenuator				ms ms
5.3.4.4	Non-interrupting level setting Attenuator fixed Attenuator electronic				dB dB
5.3.4.5	Overvoltage protection DC test RF test	O.K. O.K.			
5.3.5.1	Harmonics suppression				dBc

Section	Characteristic	Min.	Actual	Max.	Unit
5.3.5.2	Spurious, CW, offset >10 kHz				
	0.3 MHz to 450 MHz				dBc
	> 450 MHz to 1500 MHz				dBc
	> 1500 MHz to 3040 MHz				dBc
	> 3040 MHz to 3300 MHz				dBc
	Offset 10 kHz to < 900 MHz				
	> 3300 MHz to 6000 MHz				dBc
	> 6000 MHz				dBc
	Offset >=900 MHz, > 3300 MHz				dBc
	Vector modulation, offset 10 kHz to < 300 MHz				
	0.3 MHz to 3300 MHz				dBc
	Offset ≥ 300 MHz				
	0.3 MHz to 3300 MHz				dBc
	Offset 10 kHz to < 900 MHz				
	> 3300 MHz to 6000 MHz				dBc
	> 6000 MHz				dBc
	Offset >=900 MHz, > 3300 MHz				dBc
5.3.5.3	Broadband noise with CW				
	RF > 20 MHz to 450 MHz				dBc
	RF > 450 MHz to 3040 MHz				dBc
	RF > 3040 MHz to 3300 MHz				dBc
	RF > 3300 MHz to 6400 MHz				dBc
5.3.5.3	Broadband noise with vector mod., RF>20 MHz				dBc
5.3.5.4	SSB phase noise, at 20 kHz offset,				
	with CW, at RF 400 MHz				dBc(1Hz)
	1 GHz				dBc(1Hz)
	2 GHz				dBc(1Hz)
	3 GHz				dBc(1Hz)
	6 GHz				dBc(1Hz)
	with vector modulation,				
	at RF 400 MHz				dBc(1Hz)
	1 GHz				dBc(1Hz)
	2 GHz				dBc(1Hz)
	3 GHz				dBc(1Hz)
	6 GHz				dBc(1Hz)
5.3.5.5	Residual FM, rms, at 1 GHz				
	0.3 to 3 kHz (ITU-T)				Hz
	0.03 to 20 kHz				Hz
5.3.5.6	Residual AM, rms (0.03 to 20 kHz)				%
5.3.6	Sweep				
	X-AXIS	O.K.			
	MARKER	O.K.			
	BLANK	O.K.			
5.3.7	Internal modulation generator				
	Frequency drift				-
	Frequency response up to 100 kHz				dB
	up to 1 MHz				dB
	Distortion				%
	Output voltage				
	3 mV				mV
	10 mV				mV
	30 mV				mV
	100 mV				mV
	1 V				V
	2 V				V
	4 V				V

Section	Characteristic	Min.	Actual	Max.	Unit
5.3.8	Vector modulation				
	Input impedance I				-
	Input impedance Q				-
	Max. level				dB
	Error vector				
	rms value				%
	peak value				%
	Modulation frequency response				dB
	Residual carrier 0%				dBc
	Residual carrier 10%				dBc
	Imbalance (I≠Q)				
	Quadrature error				
	POW RAMP level error				dB
	POW RAMP on/off ratio				dB
	Delay time				µs
	Rise time				µs
	Fall time				µs
5.3.9	Amplitude modulation				
	Modulation depth, setting error				%
	Distortion with AM 30%				%
	with AM 80%				%
	Frequency response, RF > 5 MHz				dB
	RF <= 5 MHz				dB
	Incidental PhiM				rad
5.3.9.5	Level monitoring EXT1				
	lower limit				V
	upper limit				V
5.3.10	Broadband AM				
	Modulation frequency response 10 MHz				dB
	30 MHz				dB
5.3.11	Pulse modulation				
	On/off ratio				dB
	Rise time				µs
	Fall time				µs
	Pulse delay				µs
5.3.12.1	FM deviation setting				
	at 300 Hz				Hz
	at 1 kHz				kHz
	at 3 kHz				kHz
	at 10 kHz				kHz
	at 30 kHz				kHz
	at 100 kHz				kHz
	at 250 kHz				kHz
	at 500 kHz				kHz
5.3.12.2	FM distortion				%
5.3.12.3	FM frequency response				
	EXT1 10 Hz to 100 kHz				dB
	EXT2 10 Hz to 100 kHz				dB
	EXT1 10 Hz to 2 MHz				dB
	EXT2 10 Hz to 2 MHz				dB
	INT 10 Hz to 100 kHz				dB
	INT 10 Hz to 1MHz				dB
	FM preemphasis, deviation error				
	50 µs				%
	75 µs				%
5.3.12.5	Residual AM with FM				%
5.3.12.6	Frequency offset with FM				
	Deviation 0 Hz				Hz
	Deviation 200 Hz				Hz

Section	Characteristic	Min.	Actual	Max.	Unit
5.3.12.7	Level monitoring EXT2				
	lower limit				V
	upper limit				V
5.3.13.1	PhiM deviation setting				
	at 30 mrad				mrad
	at 0.1 rad				rad
	at 0.3 rad				rad
	at 1.0 rad				rad
	at 3.0 rad				rad
	at 10 rad				rad
5.3.13.2	PhiM distortion				%
5.3.13.3	PhiM frequency response				
	EXT1				dB
	EXT2				dB
	INT				dB
5.3.14	Digital modulation				
	2FSK, shift error				%
	4FSK, shift error				%
	GFSK, shift error				%
	GMSK, phase error				
	rms				degree
	peak				degree
	Error vector, rms, for				
	PSK, 1 ksymbol/s				%
	PSK, 18 ksymbol/s				%
	PSK, 192 ksymbol/s				%
	PSK, 1500 ksymbol/s				%
	PSK, 3000 ksymbol/s				%
	QAM, 1000 ksymbol/s				%
	QAM, 3000 ksymbol/s				%
5.3.15	Function check of data generator	O.K.			
5.3.16	Digital standards				
	GSM, phase error				
	rms				Grad
	peak				Grad
	Continuous spectrum	ok			
	Burst spectrum	ok			
	Deviation error				%
	Burst on/off				dB
	NADC, error vector, rms				%
	ACP 30 kHz				dBc
	ACP 60 kHz				dBc
	ACP 90 kHz				dBc
	PDC, error vector, rms				%
	ACP 50 kHz				dBc
	ACP 100 kHz				dBc
	PHS, error vector, rms				%
	ACP 600 kHz				dBc
	ACP 900 kHz				dBc
5.3.17	IS95 CDMA (SMIQB42), rho factor				
	reverse link				
	forward link				
	ACP reverse link				dBc
	ACP forward link				dBc
5.3.18	W-CDMA (SMIQB43), error vector				%
	ACP 5 MHz				dBc
	ACP 10 MHz				dBc

Section	Characteristic	**Min.**	**Actual**	**Max.**	**Unit**
5.3.19	W-CDMA (B45, 1 code channel),				
	Error vector				%
	ACP 5 MHz				dBc
	ACP 10 MHz				dBc
	W-CDMA (B45, 8 code channels),				
	Error vector				%
	ACP 5 MHz				dBc
	ACP 10 MHz				dBc
5.3.20	Fading simulation				
	Frequency response up to 5 MHz offset				dB
	-3 dB limit frequency				MHz
	Level error				dB
	Path attenuation error				dB
	Path delay error				ns
	Doppler shift error				%
5.3.21	Noise generation and distortion simulation				
	Bandwidth				Hz
	Frequency response up to 5 MHz				dB
	Residual carrier				dBc
	Frequency response up to I-FADED, Q-FADED				dB
	Carrier/noise ratio				
	-30 dB				dB
	-5 dB				dB
	4 dB				dB
	20 dB				dB
	Carrier/noise ratio, WorldSpace				
	-5 dB				dB
	4 dB				dB
	20 dB				dB
	Error vector				%
	Noise frequency response				
	1.29 MHz				dB
	5 MHz				dB

U

UCOR (level correction)........2.52, 3.33
Unique word (PHS)........2.120
Unit........2.5, 3.8, 3.169
Universal commands........A.3
Uplink
    DECT........2.269
    GSM........2.254
    NADC........2.215
    PDC........2.232
    PHS........2.107
Uplink signal
    3 GPPW-CDMA........2.172, 3.139
User correction (UCOR)........2.52, 3.33

V

VCO SUM calibration........2.332, 3.20
Vector modulation........2.66, 2.67, 2.285, 3.47
    calibration........2.333, 3.20
    IQ filter........2.68
    Quadrature error........5.28
    test assembly........5.4
    test procedure........5.25
Ventilation ducts........1.4
Voltage
    external modulation signal........2.56
    LF output........2.305, 3.29
VOX
    PDC........2.251, 3.106
    PHS........2.119, 3.116

W

Walsh code (CDMA)........2.137, 3.83
Waveform memory (3GPP W-CDMA)........2.172
W-CDMA........2.142
    Multicode........3.133
    test procedure........5.45
    Trigger........2.150
W-CDMA 3GPP........2.162, 3.136
    test procedure........5.46
White space........3.11

X

X field (DECT)........2.284
X_AXIS output........2.21, 2.308
XY recorder........2.308, 3.126

Z

Z field (DECT)........2.284, 3.42

A Annex A

A.1 IEC/IEEE Bus Interface

The instrument is equipped with an IEC/IEEE-bus connection as a standard. The mating connector according to IEEE 488 is at the rear of the instrument. A controller for remote control can be connected via the interface. The connection is effected using a shielded cable.

A.1.1 Characteristics of the Interface

8-bit parallel data transfer

bidirectional data transfer

three line handshake

high data transfer rate of max. 350 kByte/s

up to 15 devices can be connected

maximal length of the connecting cables 15 m (single connection 2m)

wired OR if several instruments are connected in parallel.

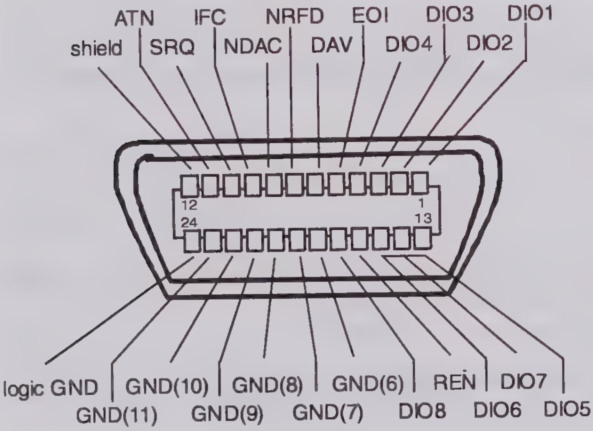


Fig. A-1 Contact Assigment of the IEC-bus socket

A.1.2 Bus Lines

1. Data bus with 8 lines DIO 1 to DIO 8.

The transmission is bit-parallel and byte-serial in the ASCII/ISO code. DIO1 is the bit of lowest order, DIO8 the bit of highest order.

2. Control bus with 5 lines.

IFC (Interface Clear),
active low resets the interfaces of the instruments connected to the default setting.

ATN (Attention),
active low signals the transmission of interface messages
inactive high signals the transmission of device-dependent messages.

SRQ (Service Request),
active low enables a device connected to send a service request to the controller.

REN (Remote Enable),
active low permits the switchover to remote control.

EOI (End or Identify),
has two functions in connection with ATN:
active low marks the end of data transmission with ATN=high
active low triggers a parallel poll with ATN=low.

3. Handshake bus with three lines.

DAV (Data Valid),
active low signals a valid data byte on the data bus.

NRFD (Not Ready For Data),
active low signals that one of the device connected is not ready for data transfer.

NDAC (Not Data Accepted),
active low as long as the instrument connected is accepting the data present on the data bus.

A.1.3 Interface Functions

Instruments which can be remote-controlled via IEC bus can be equipped with different interface functions. Table A-1 lists the interface functions appropriate for the instrument.

Table A-1 Interface function

Control character	**Interface function**
SH1	Handshake source function (source handshake)
AH1	Handshake drain function (acceptor handshake)
L4	Listener function.
T6	Talker function, ability to respond to serial poll
SR1	Service request function (Service Request)
PP1	Parallel poll function
RL1	Remote/Local switchover function
DC1	Resetting function (Device Clear)
DT1	Trigger function (Device Trigger)

A.1.4 Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They serve to communicate between instrument and controller.

Universal Commands

The universal commands are encoded in the range 10 through 1F hex. They are effective for all instruments connected to the bus without addressing them before.

Table A-2 Universal Commands

Command	**QuickBASIC commandl**	**Effect on the instrument**
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial poll
SPD (Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial poll
PPU Parallel Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of the parallel-poll polling state

Addressed Commands

The addressed commands are encoded in the range 00 through 0F hex. They are only effective for instruments addressed as listeners.

Table A-3 Addressed Commands

Command	**QuickBASIC commandl**	**Effect on the instrument**
SDC (Selected Device Clear)	IBCLR (device%)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
GET (Group Execute Trigger)	IBTRG (device%)	Triggers a previously active device function (eg a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual control)
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configure instrument for parallel poll. The QuickBASIC command additionally executes PPE / PPD.

A.2 RS-232-C Interface

The instrument is fitted with an RS-232-C interface as standard. The 9-pin connector is at the rear panel. A controller can be connected via this interface for remote control.

A.2.1 Interface characteristics

Serial data transmission in asynchronous mode

Bidirectional data transmission via two separate lines

Transmission rate selectable from 1200 to 115200 baud

Logic 0 signal from +3 V to +15 V

Logic 1 signal from -15 V to -3 V

An external instrument (controller) can be connected

Software handshake (XON, XOFF)

v Hardware handshake

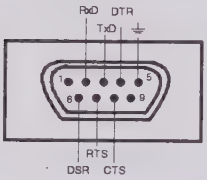


Fig. A-2 Pin assigment of RS-232-C connector

A.2.2 Signal lines

RxD (Receive Data),
Data line, transmission from external controller to instrument.

TxD (Transmit Data),
Data line, transmission from instrument to external controller.

DTR (Data terminal ready),
Output (log. 0 = active). With DTR, the instrument indicates that it is ready to receive data. The DTR line controls whether the instrument is ready for reception or not.

GND,
Interface ground, connected to instrument ground.

DSR (Data set ready),
(Instead of the CTS line, the DSR connector is used for instruments with a VAR2 REV3 front module.)

RTS (Request to send),
Output (log 0 = active). With RTS, the instrument indicates that it is ready to receive data. The RTS line controls whether the instrument is ready for reception or not.

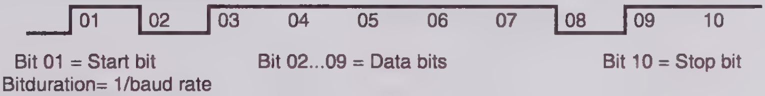
CTS (Clear to send),
Input (log 0 = active). CTS tells the instrument that the opposite station is ready to receive data.

A.2.2.1 Transmission parameters

To ensure an error-free and correct data transmission, the parameters of the instrument and the controller should have the same settings. The parameters are set in menu UTILITIES-SYSTEM-RS232.

Transmission rate (baud rate)	The following baud rates can be set in the instrument: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.
Data bits	Data transmission is in 8-bit ASCII code. The first bit transmitted is the LSB (Least Significant Bit).
Start bit	Each data byte begins with a start bit. The falling edge of the start bit indicates the beginning of the data byte.
Parity bit	A parity bit is not used.
Stop bit	The transmission of a data byte is terminated by a stop bit.

Example:
Transmission of character A (41 hex) in the 8-bit ASCII code.



A.2.3 Interface functions

For interface control, some control characters defined from 0 to 20 hex of the ASCII code can be transmitted via the interface (see Table A-4).

Table A-4 Interface functions (RS-232-C)

Control character	Interface function
<Ctrl Q> 11 hex	Enables character output (XON)
<Ctrl S> 13 hex	Inhibits character output (XOFF)
Break (at least 1 character only log 0)	Reset instrument
0Dhex, 0Ahex	Terminator <CR>, <LF> Switchover between local/remote

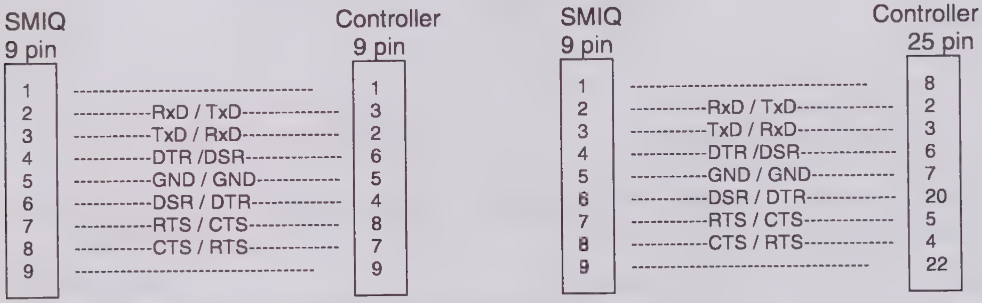
A.2.3.1 Handshake

Software handshake
The software handshake with the XON/XOFF protocol controls data transmission. If the receiver wishes to inhibit data entry, it sends XOFF to the transmitter. The transmitter then interrupts the data output until it receives a XON. The same function is provided at the transmitter side (controller).

Note: *Software handshake is not suitable for transmission of binary data. Use the hardware handshake.*

Hardware handshake
In case of a hardware handshake the instrument signals that it is ready for reception via line DTR and RTS. A logic 0 means "ready" and a 1 means "not ready". Whether the controller is ready for reception or not is signalled to the instrument via lines CTS or DSR (see signal lines). The transmitter of the instrument is switched on by a 0 and off by a 1. Line RTS remains active as long as the serial interface is active. Line DTR controls whether the instrument is ready for reception or not.

Connection between instrument and controller
Connection of the instrument with the controller is via a so-called 0-modem cable. In this case, the data, control and signalling lines have to be cross-connected. For a controller with a 9-pin or 25-pin connector the following circuit diagram applies.



SMIQ 9 pin		Controller 9 pin
1		1
2	RxD / TxD	3
3	TxD / RxD	2
4	DTR /DSR	6
5	GND / GND	5
6	DSR / DTR	4
7	RTS / CTS	8
8	CTS / RTS	7
9		9

SMIQ 9 pin		Controller 25 pin
1		8
2	RxD / TxD	2
3	TxD / RxD	3
4	DTR /DSR	6
5	GND / GND	7
6	DSR / DTR	20
7	RTS / CTS	5
8	CTS / RTS	4
9		22

Fig. A-3 Wiring of data, control and signalling lines for hardware handshake

A.3 Asynchronous Interface SERDATA

The SERDATA interface on the rear of SMIQ serves for the asynchronous serial transmission of modulation data. It is a RS-232-C interface with the following characteristics:

- Data transmission to SMIQ in one direction only via RxD line (Receive Data).
- Selectable data rate in menu UTILITIES-SYSTEM-SERDATA-BAUDRATE. The highest baud rate is 115 200.
- Hardware handshake only via RTS line (Request to send). With RTS, SMIQ is ready to receive data. After inactivating RTS, SMIQ can receive 32 bytes at max.
- Data transmission with start bit, 8 data bits (= 1 byte), stop bit. A parity bit is not used. The most significant bit of each modulation symbol has to be transmitted at first.

Note: *The baud rate has to be selected at least 25% higher than the bit rate of the digital modulation. If SMIQ has not enough data, the error message "Data underrun" will be issued in the status line.*

Connection between SERDATA and the external RS-232 data source is via a so-called null modem cable with crossed data and control lines.

B Annex B

B.1 List of Error Messages

The following list contains all error messages for errors occurring in the instrument. The meaning of negative error codes is defined in SCPI, positive error codes mark errors specific of the instrument.

The table contains the error code in the left-hand column. In the right-hand column the error text being entered into the error/event queue or being displayed is printed in bold face. Below the error text, there is an explanation as to the respective error.

B.1.1 SCPI-Specific Error Messages

No Error

Error code	**Error text in the case of queue poll** Error explanation
0	**No error** This message is output if the error queue does not contain entries.

Command Error - Faulty command; sets bit 5 in the ESR register

Error code	**Error text in the case of queue poll** Error explanation
-100	**Command Error** The command is faulty or invalid.
-101	**Invalid Character** The command contains an invalid sign. Example: A header contains an ampersand, "`SOURCE&`".
-102	**Syntax error** The command is invalid. Example: The command contains block data the instrument does not accept.
-103	**Invalid separator** The command contains an impermissible sign instead of a separator. Example: A semicolon is missing after the command.
-104	**Data type error** The command contains an invalid value indication. Example: ON is indicated instead of a numeric value for frequency setting.
-105	**GET not allowed** A Group Execute Trigger (GET) is within a command line.
-108	**Parameter not allowed** The command contains too many parameters. Example: Command `SOURce:FM:INTernal:FREQuency` permits only one frequency indication.
-109	**Missing parameter** The command contains too few parameters. Example: Command `SOURce:FM:INTernal:FREQuency` requires a frequency indication.

Continuation: Command Error

Error code	**Error text in the case of queue poll** Error explanation
-112	**Program mnemonic too long** The header contains more than 12 signs.
-113	**Undefined header** The header is not defined for the instrument. Example: `*XYZ` is undefined for every instrument.
-114	**Header suffix out of range** The header contains an impermissible numeric suffix. Example: `SOURce3` does not exist in the instrument.
-123	**Exponent too large** The absolute value of the exponent is larger than 32000.
-124	**Too many digits** The number contains too many digits.
-128	**Numeric data not allowed** The command contains a number which is not allowed at this position. Example: Command `SOURce:FREQuency:MODE` requires the indication of a text parameter.
-131	**Invalid suffix** The suffix is invalid for this instrument. Example: nHz is not defined.
-134	**Suffix too long** The suffix contains more than 12 signs.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this position of the command. Example: Command *RCL does not permit indicating a suffix.
-141	**Invalid character data** The text parameter either contains an invalid sign or it is invalid for this command Example: write error with parameter indication; `SOURce:FREQuency:MODE FIKSed.`
-144	**Character data too long** The text parameter contains more than 12 signs.
-148	**Character data not allowed** The text parameter is not allowed for this command or at this position of the command. Example: Command `*RCL` requires a number to be indicated.
-158	**String data not allowed** The command contains a valid character string at a position which is not allowed. Example: A text parameter is set in quotation marks, `SOURce:FREQuency:MODE "FIXed"`
-161	**Invalid block data** The command contains faulty block data. Example: An END message was received before the expected number of data had been received.
-168	**Block data not allowed** The command contains valid block data at an impermissible position.
-178	**Expression data not allowed** The command contains a mathematical expression at an impermissible position.

Execution Error - Error in executing the command; sets bit 4 in the ESR register

Error code	**Error text in the case of queue poll** Error explanation
-203	**Command protected** The desired command could not be executed as it was protected with a password. Use command `SYSTem:PROTect OFF`, <password> to enable the command. Example: The command `CALibrate:PULSe:MEASure?` is protected with a password.
-211	**Trigger ignored** The trigger (GET, *TRG or trigger signal) was ignored due to device timing considerations.
-221	**Settings conflict** There is a settings conflict between two parameters. Example: FM1 and PM1 cannot be switched on at the same time.
-221	**Settings conflict - Control list state vs. symbol rate** The setting CONTROL STATE ON is permissible for symbol rates up to a maximum of 2.5 MSymb/s. The symbol rate is internally limited to 2.5 MSymb/s.
-221	**Settings conflict - Filter type vs. filter parameter** The value set for the filter parameter is too large or too small for the filter type selected. The filter parameter is internally set to 0.5.
-221	**Settings conflict - Modulation type vs. coding** The modulation type and coding selected are not compatible. The coding is disactivated internally.
-221	**Settings conflict - Modulation type vs. filter type** The modulation and filter types selected are not compatible. An allowed filter type is activated internally.
-221	**Settings conflict - Modulation type vs. symbol rate** The modulation type selected (MSK or FSK) can be generated for symbol rates up to a maximum of 2.5 MSymb/s. The symbol rate is internally limited to 2.5 MSymb/s.
-221	**Settings conflict - Symbol rate vs. FSK deviation** The value set for the FSK deviation is either too large or too small for the symbol rate selected. The maximum possible value for the deviation is set.
-222	**Data out of range** The parameter value is out of the range permitted by the instrument. Example: Command *RCL only permits entries in the range of 0 to 50
-223	**Too much data** The command contains too many data. Example: The instrument does not have sufficient storage space.
-224	**Illegal parameter value** The parameter value is invalid. Example: An invalid text parameter is indicated, `TRIGger:SWEep:SOURce TASTe`
-225	**Out of memory** The storage space available in the instrument is exhausted. Example: An attempt is made to create more than 10 Memory Sequence lists.
-226	**Lists not of same length** The parts of a list have different lengths. This error message is also displayed if only part of a list has been transmitted via IEC bus. All parts of the list have to be transmitted always before it is executed. Example: The POWer list content is longer than the FREQuency list content, or only the POWer content is transmitted.

Continuation: Execution Error

Error code	**Error text in the case of queue poll** Error explanation
-230	**Data corrupt or stale** The data are incomplete or invalid. Example: The instrument has aborted a measurement.
-240	**Hardware error** The command cannot be executed due to problems with the instrument hardware.
-241	**Hardware missing** The command cannot be executed due to missing hardware. Example: An option is not fitted.
-255	**Directory full** The list management cannot accept any more lists as the maximum number of lists has already be attained. Example: Only 10 MEM SEQ lists can be created.

Device Specific Error - sets bit 3 in the ESR register.

Error code	**Error text in the case of queue poll** Error explanation
-310	**System error** This error message suggests an error within the instrument. Please inform the R&S Service.
-311	**Memory error** Error in the instrument memory.
-313	**Calibration memory lost** Loss of calibration data stored. The calibration data of VCO SUM, LEVEL PRESET and PULSE GEN can be restored by internal routines (see Chapter 2, Section Calibration).
-314	**Save/recall memory lost** Loss of the non-volatile data stored using *SAV? command.
-315	**Configuration memory lost** Loss of the non-volatile configuration data stored by the instrument.
-330	**Self-test failed** The selftest could not be executed.
-350	**Queue overflow** This error code is entered into the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been accepted. The queue can accept 5 entries.
-360	**Communication error** An error has occurred during the transmission or reception of data on the IEC/IEEE bus or via the RS-232 interface.

Query Error - Error in data request; sets bit 2 in the ESR register.

Error code	**Error text in the case of queue poll** Error explanation
-410	**Query INTERRUPTED** The query has been interrupted. Example: After a query, the instrument receives new data before the response has been sent completely.
-420	**Query UNTERMINATED** The query is incomplete. Example: The instrument is addressed as a talker and receives incomplete data.
-430	**Query DEADLOCKED** The query cannot be processed. Example: The input and output buffers are full, the instrument cannot continue operation.

B.1.2 SMIQ-Specific Error Messages

Device-dependent Error - device-specific error; sets bit 3 in the ESR register.

Error code	**Error text in the case of queue poll** Error explanation
105	**Frequency underrange** The frequency is below the limit value guaranteed.
106	**Frequency overrange** The frequency is beyond the limit value guaranteed.
110	**Output unleveled; All failure** The level control loop is without function.
111	**IQCON: ALC loop failure** The local level control loop of the IQCON module is without function.
115	**Level overrange** The level is above the limit value guaranteed.
116	**Level underrange** The level is below the limit value guaranteed.
117	**Dynamic level range exceeded** The difference between the maximal and minimal value of a level list is above 20 dBm. An exact level setting is no longer guaranteed.
130	**FM modulator VCO unlocked** FM modulator VCO is not synchronized.
131	**AM modulation frequency out of range** The AM modulation frequency is out of the permissible range.
132	**PM modulation frequency out of range** The PM modulation frequency is out of the permissible range.
140	**This modulation forces other modulations OFF** A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off.
152	**Input voltage out of range; EXT1 too high** The input voltage at the EXT1 socket is too high.
153	**Input voltage out of range; EXT1 too low** The input voltage at the EXT1 socket is too low.
154	**Input voltage out of range; EXT2 too high** The input voltage at the EXT2 socket is too high.
155	**Input voltage out of range; EXT2 too low** The input voltage at the EXT2 socket is too low.
161	**Output protection tripped** The overvoltage protection has responded (cf. Section 2.5.8).

Error code	**Error text in the case of queue poll** Error explanation
171	**Oven cold** The reference oscillator has not yet reached its operating temperature.
172	**Reference frequency 100 MHz VCXO unlocked** The 100-MHz quartz oscillator of the reference frequency has not been synchronized.
173	**Step synthesis unlocked** The step synthesis has not been synchronized.
180	**Calibration failed** Calibration could not be executed.
181	**REF OSC calibration data not used because ADJUSTMENT STATE is ON** The reference-oscillator calibration data are not used as long as ADJUSTMENT STATE is activated.
182	**Calibration data missing** Calibration data are missing in the device memory. The calibration data have to be generated first by an internal or external calibration or to be loaded into the device.
200	**Cannot access hardware** The data transmission to a module was unsuccessful.
201	**Function not supported by this hardware revision** A later version of certain parts of the instrument is necessary to execute the function selected.
202	**Diagnostic A/D converter failure** Diagnostic A/D converter has failed.
211	**Summing loop unlocked** The PLL of the summing loop has not been synchronized.
221	**Digital synthesis buffer VCO unlocked** The VCO of the buffer loop has not been synchronized.
224	**2.4 GHz LO loop unlocked** The 2.4 GHz local oszillator of the IQMOD module has not been synchronized.
231	**DATA coder clock unlocked** The clock oscillator of the data coder has not been synchronized.
232	**Cannot access data coder RAM** No data can be sent to the data coder. The data coder cannot be used as a source for a digital modulation.
240	**Invalid list; odd number of elements** The list selected contains an odd number of elements. Some lists, however, must contain an even number of elements.
241	**No list defined** There is no list defined..
242	**List not learned; execute LEARn command** The instrument has been switched to LIST mode and a list has been selected. However, command LEARn has not been executed.
243	**Dwell time adjusted** A dwell time given on a list cannot be processed by the unit. The setting was automatically adjusted.
251	**No User Correction Table; zero assumed** An attempt has been made to switch on user correction, but no UCOR table has been stored in the instrument yet. The instrument behaves as if a table was called which only contains 0-values.

Continuation: Device-dependent Error

Error code	**Error text in the case of queue poll** Error explanation
260	**Invalid keyboard input ignored** An invalid input via the keyboard is not considered.
265	**This parameter is read only** An attempt has been made to change a fixedly specified value.
270	**Data output aborted** Data output was aborted on the IEC/IEEE-bus. Example: The key [LOCAL] was pressed.
304	**String too long** A character string which is too long was received via the IEC bus. The names of lists may have a length of maximally seven letters.
305	**Fill pattern too long; trunctated** More data have been entered with block function FILL in the list editor than the filling range (RANGE) set permits. The exceeding data are ignored.
306	**No fill pattern specified** An attempt was made to execute a filler function without having to indicate a filler pattern.

C Annex C

C.1 List of Commands (with SCPI Conformity Information)

The SMIQ supports SCPI version 1994.0. For remote control, commands which were specified or accepted in this SCPI version have been used to a large extent. Commands which are not part of the SCPI specification are marked "not-SCPI" in the SCPI info.

Command	Parameter	SCPI Info	Page
:ABORt[:SWEep]		not-SCPI	3.17
:ABORt:LIST		not-SCPI	3.17
:ABORt:MSEQuence		not-SCPI	3.17
:CALibration[:ALL]			3.18
:CALibration:FSIM[:MEASure]?		not-SCPI	3.18
:CALibration:LATTenuation[:MEASure]?		not-SCPI	3.18
:CALibration:LEVel:DATA?		not-SCPI	3.19
:CALibration:LEVel:STATe	ON | OFF	not-SCPI	3.19
:CALibration:LPReset[:MEASure]?		not-SCPI	3.19
:CALibration:LPReset:DATA?		not-SCPI	3.19
:CALibration:NDSim[:MEASure]?		not-SCPI	3.19
:CALibration:ROSCillator[:DATA]	0 to 4095	not-SCPI	3.19
:CALibration:VSUMmation[:MEASure]?		not-SCPI	3.20
:CALibration:VSUMmation:OFFS?		not-SCPI	3.20
:CALibration:VSUMmation:DAC?		not-SCPI	3.20
:CALibration:VSUMmation:KOS?		not-SCPI	3.20
:CALibration:VMODulation[:MEASure]?		not-SCPI	3.20
:DIAGnostic:CLISt:CHECksum:CALculate			3.21
:DIAGnostic:CLISt:CHECksum:DATA?			3.21
:DIAGnostic:CNMeasure:MODE	CN | CARRier | NOISe		3.21
:DIAGnostic:DLISt:CHECksum:CALculate			3.22
:DIAGnostic:DLISt:CHECksum:DATA?			3.22
:DIAGnostic:INFO:CCOunt:ATTenuator1|2|3|4|5|6?			3.22
:DIAGnostic:INFO:CCOunt:POWer?			3.22
:DIAGnostic:INFO:CCOunt:MODules?			3.22
:DIAGnostic:INFO:CCOunt:OTIMe?			3.23
:DIAGnostic:INFO:CCOunt:SDATe?			3.23
:DIAGnostic[:MEASure]:POINt?			3.23
:DISPlay:ANNotation[:ALL]	ON | OFF		3.24
:DISPlay:ANNotation:AMPLitude	ON | OFF		3.24
:DISPlay:ANNotation:FREQuency	ON | OFF		3.24
:FORMat:DATA	ASCii| REAL,[32 | 64] | PACKed		3.25
:FORMat:BORDer	NORMal | SWAPped		3.25
:MEMory:NSTates?			3.26
:OUTPut:AMODe	AUTO | FIXed | ELECtronic	not-SCPI	3.27
:OUTPut:AFIXed RANGe UPPer?		not-SCPI	3.27
:OUTPut:AFIXed RANGe LOWer?		not-SCPI	3.27

Command	Parameter	SCPI Info	Page
:OUTPut:BLANk:POLarity	NORMal I INVerted	not-SCPI	3.28
:OUTPut:IMPedance?			3.28
:OUTPut:PROTection:CLEar			3.28
:OUTPut:PROTection:TRIPped?			3.28
:OUTPut[:STATe]	ON I OFF		3.28
:OUTPut[:STATe]:PON	OFF I UNCHanged	not-SCPI	3.28
:OUTPut2[:STATe]	ON I OFF		3.29
:OUTPut2:VOLTage	0V to 4V	not-SCPI	3.29
[:SOURce]:AM:BBANd[:STATe]	ON I OFF		3.31
[:SOURce]:AM[:DEPTh]	0 to 100PCT		3.31
[:SOURce]:AM:EXTernal:COUPling	AC I DC		3.31
[:SOURce]:AM:INTernal:FREQuency	0.1 Hz to1MHz		3.32
[:SOURce]:AM:SOURce	EXT I INT I EXT, INT		3.32
[:SOURce]:AM:STATe	ON I OFF		3.32
[:SOURce]:CORRection[:STATe]	ON I OFF		3.33
[:SOURce]:CORRection:CSET:CATalog?		not-SCPI	3.33
[:SOURce]:CORRection:CSET[:SELect]	'Name of table'	not-SCPI	3.33
[:SOURce]:CORRection:CSET:DATA:FREQuency	300 kHz to RF_{max} {,300 kHz to RF_{max}}	not-SCPI	3.34
[:SOURce]:CORRection:CSET:DATA:POWer	-40dB to 6dB {,-40dB to 6dB}	not-SCPI	3.34
[:SOURce]:CORRection:CSET:DELete	'Name of table'	not-SCPI	3.34
[:SOURce]:DECT:STATe	ON I OFF	not-SCPI	3.37
[:SOURce]:DECT:STANdard		not-SCPI	3.37
[:SOURce]:DECT:FORMat	GFSK I P4DQpsk	not-SCPI	3.37
[:SOURce]:DECT:FSK:DEViation	1kHz to 1,2 MHz	not-SCPI	3.37
[:SOURce]:DECT:SRATe	1kHz to 1.2 MHz	not-SCPI	3.37
[:SOURce]:DECT:FILTer:TYPE	GAUSSs I SCOSine I COSine	not-SCPI	3.37
[:SOURce]:DECT:FILTer:PARameter	0.2 to 0.7	not-SCPI	3.37
[:SOURce]:DECT:SEQuence	AUTO I RETRigger I AAUTo I ARETrigger	not-SCPI	3.37
[:SOURce]:DECT:TRIGger:SOURce	EXTernal I INTernal	not-SCPI	3.38
[:SOURce]:DECT:TRIGger:INHibit	0 to 67.1E6	not-SCPI	3.38
[:SOURce]:DECT:TRIGger:DELay	0 to 65535	not-SCPI	3.38
[:SOURce]:DECT:TRIGger:OUTPut[2]:DELay	0 to 11519	not-SCPI	3.38
[:SOURce]:DECT:TRIGger:OUTPut[2]:PERiod	1 to 67.1E6	not-SCPI	3.38
[:SOURce]:DECT:CLOCk:SOURce	INTernal I EXTernal		3.38
[:SOURce]:DECT:CLOCk:DELay	0 to 1.0	not-SCPI	3.38
[:SOURce]:DECT:PRAMp:PRESet		not-SCPI	3.39
[:SOURce]:DECT:PRAMp:TIME	0.25 to 16.0	not-SCPI	3.39
[:SOURce]:DECT:PRAMp:DELay	-1.0 to +1.0	not-SCPI	3.39
[:SOURce]:DECT:PRAMp:SHAPe	LINear I COSine	not-SCPI	3.39
[:SOURce]:DECT:PRAMp:ROFFset	-9 to +9	not-SCPI	3.39
[:SOURce]:DECT:PRAMp:FOFFset	-9 to +9	not-SCPI	3.39
[:SOURce]:DECT:SLOT:ATTenuation	0 to 70 dB	not-SCPI	3.39
[:SOURce]:DECT:SIMulation:TADJustment	-4 to +4 (in symbols)	not-SCPI	3.39
[:SOURce]:DECT:SIMulation:JITTer	0 to 4 (in symbols)	not-SCPI	3.39
[:SOURce]:DECT:FLISt:PREDefined:CATalog?	⇒name, {name}...	not-SCPI	3.40

Command	Parameter	SCPI Info	Page
[:SOURce]:DECT:FLISt:PREDefined:LOAD	'frame list name'	not-SCPI	3.40
[:SOURce]:DECT:FLISt:CATalog?	⇒name, {name}...	not-SCPI	3.40
[:SOURce]:DECT:FLISt:LOAD	'name'	not-SCPI	3.40
[:SOURce]:DECT:FLISt:STORe	'frame list name'	not-SCPI	3.40
[:SOURce]:DECT:FLISt:DELete	'name'	not-SCPI	3.40
[:SOURce]:DECT:DLISt:CATalog?	⇒name, {name}...	not-SCPI	3.40
[:SOURce]:DECT:PREamble:TYPE	NORMal | PROLonged	not-SCPI	3.40
[:SOURce]:DECT:SLOT<i>:TYPE	FULL | DOUBle | ADATa	not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:LEVel	OFF | ATT | FULL	not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:PRESet		not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:STSHift	-9 to +9 (in bit)	not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:PRAM:CW	ON | OFF	not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:PRAM:DATA	0 to 111 to (12 bit)	not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:PREamble:DATA	0 to 111 to (16 bit)	not-SCPI	3.41
[:SOURce]:DECT:SLOT<i>:PREamble:PROLonged:DATA	0 to 111 to (32 bit)	not-SCPI	3.42
[:SOURce]:DECT:SLOT<i>:SYNC	#B0 to #B111 to (16bit)	not-SCPI	3.42
[:SOURce]:DECT:SLOT<i>[:SOURce]:AFIeld	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.42
[:SOURce]:DECT:SLOT<i>[:SOURce]:AFIeld:DLISt	'name'	not-SCPI	3.42
[:SOURce]:DECT:SLOT<i>[:SOURce]:BFIeld	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.42
[:SOURce]:DECT:SLOT<i>[:SOURce]:BFIeld:DLISt	'name'	not-SCPI	3.42
[:SOURce]:DECT:SLOT<i>[:SOURce]:ZFIeld	ON | OFF	not-SCPI	3.42
[:SOURce]:DISTortion:[:STATe]	ON | OFF	not-SCPI	3.43
[:SOURce]:DISTortion:MODE	POLYnomial | DATA	not-SCPI	3.43
[:SOURce]:DISTortion:DATA:CATalog?		not-SCPI	3.44
[:SOURce]:DISTortion:DATA:SELect	'name of characteristic'	not-SCPI	3.44
[:SOURce]:DISTortion:DATA:DELete	'name of characteristic'	not-SCPI	3.44
[:SOURce]:DISTortion:DATA:DELete:ALL		not-SCPI	3.44
[:SOURce]:DISTortion:DATA:AM	-100 dB to 0 dB {,-100 dB to 0 dB} | block data	not-SCPI	3.44
[:SOURce]:DISTortion:DATA:AM:FREE?		not-SCPI	3.44
[:SOURce]:DISTortion:DATA:AM:POINts?		not-SCPI	3.44
[:SOURce]:DISTortion:DATA:AMBase	-100 dB to 0 dB {,-100 dB to 0 dB} | block data	not-SCPI	3.45
[:SOURce]:DISTortion:DATA:AMBase:POINts?		not-SCPI	3.45
[:SOURce]:DISTortion:DATA:PM	-180 degrees to +180 degrees {,-180 degrees to +180 degrees} | block data	not-SCPI	3.45
[:SOURce]:DISTortion:DATA:PM:FREE?		not-SCPI	3.45
[:SOURce]:DISTortion:DATA:PM:POINts?		not-SCPI	3.45
[:SOURce]:DISTortion:DATA:PMBase	-100 dB to 0 dB {,-100 dB to 0 dB} | block data	not-SCPI	3.45
[:SOURce]:DISTortion:DATA:PMBase:POINts?		not-SCPI	3.45
[:SOURce]:DISTortion:DATA:LEVel:CORRection	-20 to +6.00 dB	not-SCPI	3.46
[:SOURce]:DISTortion:POLYnomial:AMAM:K<i>	-10 dB to +10 dB	not-SCPI	3.46
[:SOURce]:DISTortion:POLYnomial:AMPM:K<i>	-60 deg to +60 deg	not-SCPI	3.46
[:SOURce]:DISTortion:POLYnomial:IFUNction	ON | OFF	not-SCPI	3.46
[:SOURce]:DISTortion:POLYnomial:LEVel:CORRection	-20 dB to +6 dB	not-SCPI	3.46
[:SOURce]:DISTortion:RECalculate		not-SCPI	3.46

Command	Parameter	SCPI Info	Page
[:SOURce]:DM:IQ:STATe	ON | OFF	not-SCPI	3.47
[:SOURce]:DM:IQ:PRAMp	OFF | AEXTernal	not-SCPI	3.47
[:SOURce]:DM:IQ:IMPairment[:STATe]	ON | OFF	not-SCPI	3.47
[:SOURce]:DM:LEAKage[:MAGNitude]	0 to 50.0 PCT		3.48
[:SOURce]:DM:IQ:FILTer:STATe	ON | OFF		3.48
[:SOURce]:DM:IQ:FILTer:FREQuency	850 kHz, 2.5 MHz, 5 MHz		3.48
[:SOURce]:DM:QUADrature:ANGLe	10.0 to 10.0 DEG		3.48
[:SOURce]:DM:IQRatio[:MAGNitude]	-12.0 to 12.0 PCT		3.48
[:SOURce]:DM:IQSWap[:STATe]	ON | OFF	not-SCPI	3.48
[:SOURce]:DM:STATe	ON | OFF		3.51
[:SOURce]:DM:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger | SINGle	not-SCPI	3.51
[:SOURce]:DM:SOURce	PRBS | PATTern | DLISt | SERial | PARallel | SDATa		3.51
[:SOURce]:DM:PATTern	ZERO | ONE | ALTernate	not-SCPI	3.51
[:SOURce]:DM:PRBS[:LENGth]	9 | 15 | 16 | 20 | 21 | 23	not-SCPI	3.51
[:SOURce]:DM:DLISt:DATA	0 | 1 {,0 | 1 }..	not-SCPI	3.52
[:SOURce]:DM:DLISt:DATA?	[<start> [,<length>]]	not-SCPI	3.52
[:SOURce]:DM:DLISt:DATA:APPend	0 | 1 {,0 | 1 }..	not-SCPI	3.52
[:SOURce]:DM:DLISt:CATalog?		not-SCPI	3.52
[:SOURce]:DM:DLISt:SELect	'<name>'	not-SCPI	3.53
[:SOURce]:DM:DLISt:DELete	'<name>'	not-SCPI	3.53
[:SOURce]:DM:DLISt:COPY	'<name>'	not-SCPI	3.53
[:SOURce]:DM:DLISt:FREE?		not-SCPI	3.53
[:SOURce]:DM:DLISt:POINts	<n>	not-SCPI	3.53
[:SOURce]:DM:CLISt:CONTrol[:STATe]	ON | OFF	not-SCPI	3.53
[:SOURce]:DM:CLISt:DATA	<struc>{,<struc>}...	not-SCPI	3.54
[:SOURce]:DM:CLISt:CATalog?		not-SCPI	3.54
[:SOURce]:DM:CLISt:SELect	'<name>'	not-SCPI	3.54
[:SOURce]:DM:CLISt:DELete	'<name>'	not-SCPI	3.54
[:SOURce]:DM:CLISt:COPY	'<name>'	not-SCPI	3.54
[:SOURce]:DM:CLISt:FREE?		not-SCPI	3.55
[:SOURce]:DM:CLISt:POINts?		not-SCPI	3.55
[:SOURce]:DM:MLISt:DATA	A,B,C,D,E,F,I1,Q1,I2,Q2...	not-SCPI	3.55
[:SOURce]:DM:MLISt:CATalog?		not-SCPI	3.55
[:SOURce]:DM:MLISt:SELect	'<name>'	not-SCPI	3.56
[:SOURce]:DM:MLISt:DELete	'<name>'	not-SCPI	3.56
[:SOURce]:DM:MLISt:FREE?		not-SCPI	3.56
[:SOURce]:DM:MLISt:POINts?		not-SCPI	3.56
[:SOURce]:DM:STANDard	APCFm | APCQpsk | CDPD | CT2 | DECT | GSM | GSMEdge | IRIDium | FIS95 | RIS95 | NADC | PDC | PHS | TETRa | TFTS | PWT | ICOBpsk | ICOGmsk | ICOQpsk | WORLdspace | QWCDma | AT55	not-SCPI	3.56

Command	Parameter	SCPI Info	Page
[:SOURce]:DM:FORMat	BPSK | QPSK | QIS95 | QINMarsat | QICO | QWCDma | OQPSk | OIS95 | P4QPsk | P4DQpsk | PSK8 | PSKE8 | GFSK | GMSK | ASK | FSK2 | FSK4 | AFSK4 | QAM16 | QAM32 | QAM 64 | QAM256 | USER		3.56
[:SOURce]:DM:MDELay?		not-SCPI	3.57
[:SOURce]:DM:FSK:DEViation	100Hz to 2.5 MHz	not-SCPI	3.57
[:SOURce]:DM:SRATe	1kHz to 7 MHz		3.57
[:SOURce]:DM:FILTer:TYPE	SCOSine | COSine | GAUSs | BESS1 | BESS2 | IS95 | EIS95 | APCO | TETRa | WCDMa | RECTangle | SPHase	not-SCPI	3.57
[:SOURce]:DM:FILTer:PARameter	0.1to 1.0		3.57
[:SOURce]:DM:FILTer:MODE	LACP | LEVM	not-SCPI	3.57
[:SOURce]:DM:CODing	OFF | DIFF | DPHS | DGRay | GSM | NADC | PDC | PHS | TETRa | TFTS | INMarsat | APCO25 | VDL	not-SCPI	3.57
[:SOURce]:DM:CLOCk:SOURce	INTernal | EXTernal | COUPled		3.58
[:SOURce]:DM:CLOCk:MODE	BIT | SYMBol	not-SCPI	3.58
[:SOURce]:DM:CLOCk:DELay	0 to 1.0	not-SCPI	3.58
[:SOURce]:DM:CLOCk:POLarity	NORMal | INVerted	not-SCPI	3.58
[:SOURce]:DM:LDIStortion[:STATe]	ON | OFF	not-SCPI	3.58
[:SOURce]:DM:PRAMp[:STATe]	ON | OFF	not-SCPI	3.58
[:SOURce]:DM:PRAMp:SOURce	CLISt | AEXTernal | DEXTernal	not-SCPI	3.59
[:SOURce]:DM:PRAMp:TIME	0.25 to 32	not-SCPI	3.59
[:SOURce]:DM:PRAMp:DELay	-1.0 to +5.0	not-SCPI	3.59
[:SOURce]:DM:PRAMp:SHAPe	LINear | COSine	not-SCPI	3.59
[:SOURce]:DM:PRAMp:ATTenuation	0 to 70dB	not-SCPI	3.59
[:SOURce]:DM:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.59
[:SOURce]:DM:TRIGger:INHibit	0 to 67.1E6	not-SCPI	3.59
[:SOURce]:DM:TRIGger:DELay	0 to 65535	not-SCPI	3.59
[:SOURce]:DM:TRIGger:SLOPe	POSitive | NEGative	not-SCPI	3.60
[:SOURce]:DM:THReshold[:ALL]	-2.5 to 2.5 V		3.60
[:SOURce]:DM:INPut:IMPedance	G1K | G50 | ECL	not-SCPI	3.60
[:SOURce]:FM1|2[:DEViation]	0 to 1 MHz		3.61
[:SOURce]:FM1|2:EXTernal1|2:COUPling	AC | DC		3.61
[:SOURce]:FM1|2:INTernal:FREQuency	0.1 Hz to 1 MHz		3.62
[:SOURce]:FM1|2:PREemphasis	0 | 50us | 75us		3.62
[:SOURce]:FM1|2:SOURce	INTernal | EXTernal1 | EXTernal2		3.62
[:SOURce]:FM1|2:STATe	ON | OFF		3.62
[:SOURce]:FREQuency:CENTer	300 kHz to RF_{max}		3.63
[:SOURce]:FREQuency[:CW|:FIXed]	300 kHz to RF_{max}		3.63
[:SOURce]:FREQuency[:CW|:FIXed]:RCL	INCLude | EXCLude		3.63
[:SOURce]:FREQuency:MANual	300 kHz to RF_{max}		3.64
[:SOURce]:FREQuency:MODE	CW | FIXed | SWEep | LIST		3.64
[:SOURce]:FREQuency:OFFSet	-50 to +50 GHz		3.64
[:SOURce]:FREQuency:SPAN	0 to RF_{max}		3.64
[:SOURce]:FREQuency:STARt	300 kHz to RF_{max}		3.64
[:SOURce]:FREQuency:STOP	300 kHz to RF_{max}		3.65
[:SOURce]:FREQuency:STEP[:INCRement]	0 to 1 GHz		3.65

Command	Parameter	SCPI Info	Page
[:SOURce]:FSIMulator[:STATe]	ON | OFF	not-SCPI	3.67
[:SOURce]:FSIMulator:CONFigure	S6Path | S12Path | D6Path	not-SCPI	3.67
[:SOURce]:FSIMulator:SEQuence	RUN | STOP	not-SCPI	3.67
[:SOURce]:FSIMulator:SEQuence:RESet		not-SCPI	3.67
[:SOURce]:FSIMulator:STANdard	CDMA8 | CDMA30 | CDMA100 | NADC8 | NADC50 | NADC100 | GTU3 | GTU50 | GHT100 | GRA250 | GET50 | GET100 | PTU1 | PTU50 | PTU100 | PHT100 | PRA130 | PET50 | PET100 | TTU | THT | TET	not-SCPI	3.67
[:SOURce]:FSIMulator:SPEed:UNIT	MPS | KMPH | MPH	not-SCPI	3.68
[:SOURce]:FSIMulator:ILOSs:MODE	NORMal | LACP	not-SCPI	3.68
[:SOURce]:FSIMulator:COUPle:SPEed?	ON | OFF	not-SCPI	3.68
[:SOURce]:FSIMulator:COUPle:CORRelation:COEFficient	ON | OFF	not-SCPI	3.68
[:SOURce]:FSIMulator:COUPle:LOGNormal:LCONstant	ON | OFF	not-SCPI	3.68
[:SOURce]:FSIMulator:COUPle:LOGNormal:CSTD	ON | OFF	not-SCPI	3.68
[:SOURce]:FSIMulator:CFACtor:EXTern?	not-SCPI	3.68	
[:SOURce]:FSIMulator:DEFault		not-SCPI	3.68
[:SOURce]:FSIMulator:PATH<i>:STATE	ON | OFF	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:PROFile	PDOPpler | RAYLeigh | RICE | CPHase	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:DCOMponent:STATe	ON | OFF	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:PRATio	-30 to +30 dB	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:FRATio	-1 to +1	not-SCPI	3.69
[:SOURce]:FSIMulator<k>:PATH<i>:CPHase	0 to 360 DEG	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:SPEed	0.005 to 27777 (in MPS; m/s)	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:FDOPpler	0.1 to 1600 Hz	not-SCPI	3.69
[:SOURce]:FSIMulator:PATH<i>:LOSS	0 to 50.0 dB	not-SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:DELay	0 to 1638.0 E-6 S	not-SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:CORRelation:PATH	0 | 7 to 12	not SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:CORRelation:COEFficent	0 to 1.0	not-SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:CORRelation:PHASe	0 to 359 DEG	not-SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:LOGNormal:STATe	ON | OFF	not-SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:LOGNormal:LCONstant	0 to 99 999 (in m)	not-SCPI	3.70
[:SOURce]:FSIMulator:PATH<i>:LOGNormal:CSTD	0 to 12.0 dB	not-SCPI	3.70
[:SOURce]:GSM:STATe	ON | OFF	not-SCPI	3.72
[:SOURce]:GSM:STANdard		not-SCPI	3.72
[:SOURce]:GSM:FORMat	GMSK | GFSK	not-SCPI	3.73
[:SOURce]:GSM:FSK:DEViation	1kHz to 300 kHz	not-SCPI	3.73
[:SOURce]:GSM:SRATe	1kHz to 300 kHz	not-SCPI	3.73
[:SOURce]:GSM:FILTer:PARameter	0.2 to 0.7	not-SCPI	3.73
[:SOURce]:GSM:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger	not-SCPI	3.73
[:SOURce]:GSM:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.73
[:SOURce]:GSM:TRIGger:INHibit	0 to 67.1E6	not-SCPI	3.73
[:SOURce]:GSM:TRIGger:DELay	0 to 65535	not-SCPI	3.73
[:SOURce]:GSM:TRIGger:OUTPut[2]:DELay	0 to 1249	not-SCPI	3.73
[:SOURce]:GSM:TRIGger:OUTPut[2]:PERiod	1 to 67.1E6	not-SCPI	3.74
[:SOURce]:GSM:CLOCk:SOURce	INTernal | EXTernal		3.74

Command	Parameter	SCPI Info	Page
[:SOURce]:GSM:CLOCk:DELay	0 to 1.0	not-SCPI	3.74
[:SOURce]:GSM:PRAMp:PRESet		not-SCPI	3.74
[:SOURce]:GSM:PRAMp:TIME	0.25 to 16.0	not-SCPI	3.74
[:SOURce]:GSM:PRAMp:DELay	-1.0 to + 1.0	not-SCPI	3.74
[:SOURce]:GSM:PRAMp:SHAPe	LINear | COSine	not-SCPI	3.74
[:SOURce]:GSM:PRAMp:ROFFset	-9 to +9	not-SCPI	3.75
[:SOURce]:GSM:PRAMp:FOFFset	-9 to +9	not-SCPI	3.75
[:SOURce]:GSM:SLOT:ATTenuation	0 to -70 dB	not-SCPI	3.75
[:SOURce]:GSM:FLISt:PREDefined:CATalog?	⇒name, {name}...	not-SCPI	3.75
[:SOURce]:GSM:FLISt:PREDefined:LOAD	'name'	not-SCPI	3.75
[:SOURce]:GSM:FLISt:CATalog?		not-SCPI	3.75
[:SOURce]:GSM:FLISt:LOAD	'name'	not-SCPI	3.75
[:SOURce]:GSM:FLISt:STORe	'name'	not-SCPI	3.75
[:SOURce]:GSM:FLISt:DELete	'name'	not-SCPI	3.76
[:SOURce]:GSM:DLISt:CATalog?	⇒name, {name}...	not-SCPI	3.76
[:SOURce]:GSM:SLOT<i>:TYPE	NORM | DUMMy | ADATa	not-SCPI	3.76
[:SOURce]:GSM:SLOT<i>:LEVel	OFF | ATT | FULL	not-SCPI	3.76
[:SOURce]:GSM:SLOT<i>:PRESet		not-SCPI	3.76
[:SOURce]:GSM:SLOT<i>:HOPPing:TRIGger	ON | OFF	not-SCPI	3.76
[:SOURce]:GSM:SLOT<i>[:SOURce]:DATA	PN9 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.76
[:SOURce]:GSM:SLOT<i>[:SOURce]:DATA:DLISt	'name'	not-SCPI	3.77
[:SOURce]:GSM:SLOT<i>:SF	0 | 1	not-SCPI	3.77
[:SOURce]:GSM:SLOT<i>:TSC:SELect	T0 to T7 | USER	not-SCPI	3.77
[:SOURce]:GSM:SLOT<i>:TSC:USER	#B0 to #B1111 to (26 bits)	not-SCPI	3.77
[:SOURce]:IS95:STATe	ON | OFF	not-SCPI	3.79
[:SOURce]:IS95:MODE	FLINk18 | FLINk64 | RLINk | RLCoded	not-SCPI	3.79
[:SOURce]:IS95:PRESet		not-SCPI	3.79
[:SOURce]:IS95:CRATe	1kHz to 7MHz	not-SCPI	3.79
[:SOURce]:IS95:FILTer:FTYPe	SCOSine | COSine | IS95 | EIS95	not-SCPI	3.80
[:SOURce]:IS95:FILTer:RTYPe	SCOSine | COSine | IS95 | EIS95	not-SCPI	3.80
[:SOURce]:IS95:FILTer:PARameter	0.1 to 0.7	not-SCPI	3.80
[:SOURce]:IS95:FILTer:MODE	LACP | LEVM	not-SCPI	3.80
[:SOURce]:IS95:LDIStortion[:STATe]	ON | OFF	not-SCPI	3.80
[:SOURce]:IS95:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger	not-SCPI	3.80
[:SOURce]:IS95:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.81
[:SOURce]:IS95:TRIGger:INHibit	0 to 65535	not-SCPI	3.81
[:SOURce]:IS95:TRIGger:DELay	0 to 65535	not-SCPI	3.81
[:SOURce]:IS95:TRIGger:OUTPut[1]|2	TFRame | SSRollover | SFRame | ESECond | GATE	not-SCPI	3.81
[:SOURce]:IS95:TRIGger:OUTPut[1]|2:DELay	-32768 to 32768	not-SCPI	3.81
[:SOURce]:IS95:TRIGger:OUTPut[1]|2:POLarity	POSitive | NEGative	not-SCPI	3.81
[:SOURce]:IS95:CLOCk:MODE	CHIP | CHIP4 | CHIP8 | CHIP16	not-SCPI	3.81
[:SOURce]:IS95:CLOCk:SOURce	INTernal | EXTernal		3.82
[:SOURce]:IS95:CLOCk:DELay	0 to 1.00	not-SCPI	3.82
[:SOURce]:IS95:POWer?		not-SCPI	3.82

Command	Parameter	SCPI Info	Page
[:SOURce]:IS95:POWer:ADJust		not-SCPI	3.82
[:SOURce]:IS95:MAPPing:PREDefined:CATalog?	⇒name, {name}...	not-SCPI	3.82
[:SOURce]:IS95:MAPPing:PREDefined:LOAD	‘name’	not-SCPI	3.82
[:SOURce]:IS95:MAPPing:CATalog?		not-SCPI	3.82
[:SOURce]:IS95:MAPPing:LOAD	‘name’	not-SCPI	3.82
[:SOURce]:IS95:MAPPing:STORe	‘name’	not-SCPI	3.83
[:SOURce]:IS95:MAPPing:DELete	‘name’	not-SCPI	3.83
[:SOURce]:IS95:CHANnel<1 to 17>:WALShcode	0 to 63	not-SCPI	3.83
[:SOURce]:IS95:CHANnel<0 to 3>:POWer	-30 dB to 0 dB	not-SCPI	3.83
[:SOURce]:IS95:CHANnel<1 to 63>:DATA	ZERO | ONE | ALTernate | PRBS	not-SCPI	3.83
[:SOURce]:IS95:CHANnel<0 to 63>:STATe	ON | OFF	not-SCPI	3.83
[:SOURce]:IS95:RATE	FULL | HALF	not-SCPI	3.84
[:SOURce]:IS95:RANDomizer	ON | OFF	not-SCPI	3.84
[:SOURce]:IS95:DATA	ZERO | ONE | ALTernate | PRBS | DLISt	not-SCPI	3.84
[:SOURce]:IS95:DLISt	’name’	not-SCPI	3.84
[:SOURce]:IS95:DLISt:CATalog?		not-SCPI	3.84
[:SOURce]:IS95:RLCoded:CTYPe	TRAF14400 | TRAF7200 | TRAF3600 | TRAF1800 | ACC4800 | TRAF9600 | TRAF4800 | TRAF2400 | TRAF1200	not-SCPI	3.84
[:SOURce]:IS95:RLCoded:DATA	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt	not-SCPI	3.84
[:SOURce]:IS95:RLCoded:DLISt	’name’	not-SCPI	3.85
[:SOURce]:IS95:RLCoded:FQINdicator	ON | OFF	not-SCPI	3.85
[:SOURce]:IS95:RLCoded:CENCoder	ON | OFF	not-SCPI	3.85
[:SOURce]:IS95:RLCoded:BINTerleaver	ON | OFF	not-SCPI	3.85
[:SOURce]:IS95:RLCoded:EBIT	0 | 1	not-SCPI	3.85
[:SOURce]:LIST:CATalog?		not-SCPI	3.86
[:SOURce]:LIST:DELete	`Name of list'	not-SCPI	3.86
[:SOURce]:LIST:DELete:ALL		not-SCPI	3.86
[:SOURce]:LIST:DWELl	1 ms to 1 s {, 1 ms to 1 s}		3.87
[:SOURce]:LIST:DWELl:POINts?			3.87
[:SOURce]:LIST:FREE?			3.87
[:SOURce]:LIST:FREQuency	300 kHz to RF_{max} {, 300 kHz to RF_{max}} | block data		3.87
[:SOURce]:LIST:FREQuency:POINts?			3.87
[:SOURce]:LIST:LEARn		not-SCPI	3.87
[:SOURce]:LIST:MODE	AUTO | STEP	not-SCPI	3.87
[:SOURce]:LIST:POWer	-144 to16 dBm {, -144 to16 dBm} | block data		3.88
[:SOURce]:LIST:POWer:POINts?			3.88
[:SOURce]:LIST[:SELect]	'Name of list'	not-SCPI	3.88
[:SOURce]:MARKer1|2|3[:FSWeep]:AMPLitude	ON | OFF		3.89
[:SOURce]:MARKer1|2|3[:FSWeep]:AOFF			3.89
[:SOURce]:MARKer1|2|3[:FSWeep]:FREQuency	300 kHz to RF_{max}		3.89
[:SOURce]:MARKer1|2|3[:FSWeep][:STATe]	ON | OFF		3.90
[:SOURce]:MARKer1|2|3:PSWeep:AOFF		not-SCPI	3.90
[:SOURce]:MARKer1|2|3:PSWeep:POWer	-144 dBm to+16 dBm	not-SCPI	3.90

Command	Parameter	SCPI Info	Page
[:SOURce]:MARKer1|2|3:PSWeep[:STATe]	ON | OFF	not-SCPI	3.90
[:SOURce]:MARKer1|2|3:POLarity	NORMal | INVerted	not-SCPI	3.90
[:SOURce]:NADC:STATe	ON | OFF	not-SCPI	3.92
[:SOURce]:NADC:STANdard		not-SCPI	3.92
[:SOURce]:NADC:SRATe	1kHz to 200 kHz	not-SCPI	3.93
[:SOURce]:NADC:FILTer:TYPE	SCOSine | COSine	not-SCPI	3.93
[:SOURce]:NADC:FILTer:PARameter	0.1 to 0.7	not-SCPI	3.93
[:SOURce]:NADC:FILTer:MODE	LACP | LEVM	not-SCPI	3.93
[:SOURce]:NADC:LDIStortion[:STATe]	ON | OFF	not-SCPI	3.93
[:SOURce]:NADC:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger	not-SCPI	3.93
[:SOURce]:NADC:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.93
[:SOURce]:NADC:TRIGger:INHibit	0 to 67.1E6	not-SCPI	3.93
[:SOURce]:NADC:TRIGger:DELay	0 to 65535	not-SCPI	3.94
[:SOURce]:NADC:TRIGger:OUTPut[2]:DELay	0 to 971	not-SCPI	3.94
[:SOURce]:NADC:TRIGger:OUTPut[2]:PERiod	1 to 67.1E6	not-SCPI	3.94
[:SOURce]:NADC:CLOCk:SOURce	INTernal | EXTernal		3.94
[:SOURce]:NADC:CLOCk:MODE	BIT | SYMBol	not-SCPI	3.94
[:SOURce]:NADC:CLOCk:DELay	0 to 1.0	not-SCPI	3.94
[:SOURce]:NADC:PRAMp:PRESet		not-SCPI	3.95
[:SOURce]:NADC:PRAMp:TIME	0.25 to 16.0	not-SCPI	3.95
[:SOURce]:NADC:PRAMp:DELay	-1.0 to + 1.0	not-SCPI	3.95
[:SOURce]:NADC:PRAMp:SHAPe	LINear | COSine	not-SCPI	3.95
[:SOURce]:NADC:PRAMp:ROFFset	-9 to +9	not-SCPI	3.95
[:SOURce]:NADC:PRAMp:FOFFset	-9 to +9	not-SCPI	3.95
[:SOURce]:NADC:SLOT:ATTenuation	0 to -70 dB	not-SCPI	3.95
[:SOURce]:NADC:LINK	UP | DOWN	not-SCPI	3.95
[:SOURce]:NADC:RCONfiguration	AHALf | FULL1 | FULL2 | FULL3 | FULL12 | FULL13 | FULL23 | AFUL	not-SCPI	3.96
[:SOURce]:NADC:FLISt:PREDefined:CATalog?	⇒name, {name}...	not-SCPI	3.96
[:SOURce]:NADC:FLISt:PREDefined:LOAD	'name'	not-SCPI	3.96
[:SOURce]:NADC:FLISt:CATalog?		not-SCPI	3.96
[:SOURce]:NADC:FLISt:LOAD	'name'	not-SCPI	3.96
[:SOURce]:NADC:FLISt:STORe	'name'	not-SCPI	3.96
[:SOURce]:NADC:FLISt:DELete	'name'	not-SCPI	3.97
[:SOURce]:NADC:DLISt:CATalog?	⇒name, {name}...	not-SCPI	3.97
[:SOURce]:NADC:SLOT<i>:TYPE	TCH | SHORt | ADATa	not-SCPI	3.97
[:SOURce]:NADC:SLOT<i>:LEVel	OFF | ATT | FULL	not-SCPI	3.97
[:SOURce]:NADC:SLOT<i>:PRESet		not-SCPI	3.97
[:SOURce]:NADC:SLOT<i>[:SOURce]:SACChannel	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.98
[:SOURce]:NADC:SLOT<i>[:SOURce]:SACChannel:DLISt	'name'	not-SCPI	3.98
[:SOURce]:NADC:SLOT<i>[:SOURce]:DATA	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.98
[:SOURce]:NADC:SLOT<i>[:SOURce]:DATA:DLISt	'name'	not-SCPI	3.98
[:SOURce]:NADC:SLOT<i>:SYNC	#H0 to #HFFFFFFF (28 bit)	not-SCPI	3.98
[:SOURce]:NADC:SLOT<i>:CDVCc	#H0 to #HFFF (8 bit)	not-SCPI	3.98
[:SOURce]:NADC:SLOT<i>:RSVD	#H800 to #HFFF (8 bit)	not-SCPI	3.98

Command	Parameter	SCPI Info	Page
[:SOURce]:NOISe[:STATe]	ON I OFF	not-SCPI	3.99
[:SOURce]:NOISe:SNRatio	-5.0 to 30.0 dB	not-SCPI	3.99
[:SOURce]:NOISe:BANDwidthIBWIDth	10000 to 10000000 Hz	not-SCPI	3.99
[:SOURce]:PDC:STATe	ON I OFF	not-SCPI	3.101
[:SOURce]:PDC:STANdard		not-SCPI	3.102
[:SOURce]:PDC:SRATe	1kHz to 200 kHz	not-SCPI	3.102
[:SOURce]:PDC:FILTer:TYPE	SCOSine I COSine	not-SCPI	3.102
[:SOURce]:PDC:FILTer:PARameter	0.1 to 0.7	not-SCPI	3.102
[:SOURce]:PDC:FILTer:MODE	LACP I LEVM	not-SCPI	3.102
[:SOURce]:PDC:LDIStortion[:STATe]	ON I OFF	not-SCPI	3.102
[:SOURce]:PDC:SEQuence	AUTO I RETRigger I AAUTo I ARETrigger	not-SCPI	3.102
[:SOURce]:PDC:TRIGger:SOURce	EXTernal I INTernal	not-SCPI	3.102
[:SOURce]:PDC:TRIGger:INHibit	0 to 67.1E6	not-SCPI	3.103
[:SOURce]:PDC:TRIGger:DELay	0 to 65535	not-SCPI	3.103
[:SOURce]:PDC:TRIGger:OUTPut[2]:DELay	0 to 959	not-SCPI	3.103
[:SOURce]:PDC:TRIGger:OUTPut[2]:PERiod	1 to 67.1M	not-SCPI	3.103
[:SOURce]:PDC:CLOCk:SOURce	INTernal I EXTernal		3.103
[:SOURce]:PDC:CLOCk:MODE	BIT I SYMBol	not-SCPI	3.103
[:SOURce]:PDC:CLOCk:DELay	0 to 1.0	not-SCPI	3.103
[:SOURce]:PDC:PRAMp:PRESet		not-SCPI	3.104
[:SOURce]:PDC:PRAMp:TIME	0.25 to 16.0	not-SCPI	3.104
[:SOURce]:PDC:PRAMp:DELay	-1.0 to + 1.0	not-SCPI	3.104
[:SOURce]:PDC:PRAMp:SHAPe	LINear I COSine	not-SCPI	3.104
[:SOURce]:PDC:PRAMp:ROFFset	-9 to +9	not-SCPI	3.104
[:SOURce]:PDC:PRAMp:FOFFset	-9 to +9	not-SCPI	3.104
[:SOURce]:PDC:SLOT:ATTenuation	0 to 70 dB	not-SCPI	3.104
[:SOURce]:PDC:LINK	UP I DOWN	not-SCPI	3.105
[:SOURce]:PDC:RCONfiguration	AHALf I FULL1 I FULL2 I FULL3 I FULL12 I FULL13 I FULL23 I AFUL	not-SCPI	3.105
[:SOURce]:PDC:FLISt:PREDefined:CATalog?	⇒name, {name}...	not-SCPI	3.105
[:SOURce]:PDC:FLISt:PREDefined:LOAD	'name'	not-SCPI	3.105
[:SOURce]:PDC:FLISt:CATalog?		not-SCPI	3.105
[:SOURce]:PDC:FLISt:LOAD	'name'	not-SCPI	3.106
[:SOURce]:PDC:FLISt:STORe	'name'	not-SCPI	3.106
[:SOURce]:PDC:FLISt:DELete	'name'	not-SCPI	3.106
[:SOURce]:PDC:DLISt:CATalog?	⇒name, {name}...	not-SCPI	3.106
[:SOURce]:PDC:SLOT<i>:TYPE	TCH I SYNC I VOX I ADATa	not-SCPI	3.106
[:SOURce]:PDC:SLOT<i>:LEVel	OFF I ATT I FULL	not-SCPI	3.106
[:SOURce]:PDC:SLOT<i>:PRESet		not-SCPI	3.107
[:SOURce]:PDC:SLOT<i>:SCRamble:STATe	ON I OFF	not-SCPI	3.107
[:SOURce]:PDC:SLOT<i>SCRamble:STARt	#H1 to #H1FF (9 bit)	not-SCPI	3.107
[:SOURce]:PDC:SLOT<i>:SFRame:STATe	ON I OFF	not-SCPI	3.107
[:SOURce]:PDC:SLOT<i>:SFRame:RCHPosition	1 to 17	not-SCPI	3.107
[:SOURce]:PDC:SLOT<i>[:SOURce]:DATA	PN9 I PN11 I PN15 I PN16 I PN20 I PN21 I PN23 I DLISt I SDATa	not-SCPI	3.107
[:SOURce]:PDC:SLOT<i>[:SOURce]:DATA:DLISt	'name'	not-SCPI	3.108

Command	Parameter	SCPI Info	Page
[:SOURce]:PDC:SLOT<i>[:SOURce]:SACChannel	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.108
[:SOURce]:PDC:SLOT<i>[:SOURce]:SACChannel:DLISt	name'	not-SCPI	3.108
[:SOURce]:PDC:SLOT<i>[:SOURce]:RCHannel	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.108
[:SOURce]:PDC:SLOT<i>[:SOURce]:RCHannel:DLISt	'name'	not-SCPI	3.108
[:SOURce]:PDC:SLOT<i>[:SOURce]:SI	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.108
[:SOURce]:PDC:SLOT<i>[:SOURce]:SI:DLISt	'name'	not-SCPI	3.108
[:SOURce]:PDC:SLOT<i>:PREamble	#H0 to #H...(2/6/48/102 bits)	not-SCPI	3.109
[:SOURce]:PDC:SLOT<i>:SYNC	#H1 to #H17	not-SCPI	3.109
[:SOURce]:PDC:SLOT<i>:SYNC2	#H0 to #HFF... (20/32 bits)	not-SCPI	3.109
[:SOURce]:PDC:SLOT<i>:CCODe	#H0 to #HFF (8 bits)	not-SCPI	3.109
[:SOURce]:PDC:SLOT<i>:POSTamble	#H0 to #H3FF... (78 bits)	not-SCPI	3.109
[:SOURce]:PDC:SLOT<i>:SF	0 | 1	not-SCPI	3.109
[:SOURce]:PHASe[:ADJust]	-360 deg to +360 deg	not-SCPI	3.110
[:SOURce]:PHASe:REFerence		not-SCPI	3.110
[:SOURce]:PHS:STATe	ON | OFF	not-SCPI	3.112
[:SOURce]:PHS:STANdard		not-SCPI	3.113
[:SOURce]:PHS:SRATe	1kHz to 200 kHz	not-SCPI	3.113
[:SOURce]:PHS:FILTer:TYPE	SCOSine | COSine	not-SCPI	3.113
[:SOURce]:PHS:FILTer:PARameter	0.1 to 0.7	not-SCPI	3.113
[:SOURce]:PHS:FILTer:MODE	LACP | LEVM	not-SCPI	3.113
[:SOURce]:PHS:LDIStortion[:STATe]	ON | OFF	not-SCPI	3.113
[:SOURce]:PHS:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger	not-SCPI	3.113
[:SOURce]:PHS:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.113
[:SOURce]:PHS:TRIGger:INHibit	0 to 67.1E6	not-SCPI	3.114
[:SOURce]:PHS:TRIGger:DELay	0 to 65535	not-SCPI	3.114
[:SOURce]:PHS:TRIGger:OUTPut[2]:DELay	0 to 959	not-SCPI	3.114
[:SOURce]:PHS:TRIGger:OUTPut[2]:PERiod	1 to 67.1E6	not-SCPI	3.114
[:SOURce]:PHS:CLOCk:SOURce	INTernal | EXTernal		3.114
[:SOURce]:PHS:CLOCk:MODE	BIT | SYMBol	not-SCPI	3.114
[:SOURce]:PHS:CLOCk:DELay	0 to 1.0	not-SCPI	3.114
[:SOURce]:PHS:PRAMp:PRESet		not-SCPI	3.115
[:SOURce]:PHS:PRAMp:TIME	0.25 to 16.0	not-SCPI	3.115
[:SOURce]:PHS:PRAMp:DELay	-1.0 to + 1.0	not-SCPI	3.115
[:SOURce]:PHS:PRAMp:SHAPe	LINear | COSine	not-SCPI	3.115
[:SOURce]:PHS:PRAMp:ROFFset	-9 to +9	not-SCPI	3.115
[:SOURce]:PHS:PRAMp:FOFFset	-9 to +9	not-SCPI	3.115
[:SOURce]:PHS:SLOT:ATTenuation	0 to 70 dB	not-SCPI	3.115
[:SOURce]:PHS:FLISt:PREDefined:CATalog?	⇒name, {name}...	not-SCPI	3.116
[:SOURce]:PHS:FLISt:PREDefined:LOAD	'name'	not-SCPI	3.116
[:SOURce]:PHS:FLISt:CATalog?		not-SCPI	3.116
[:SOURce]:PHS:FLISt:LOAD	'name'	not-SCPI	3.116
[:SOURce]:PHS:FLISt:STORe	'name'	not-SCPI	3.116
[:SOURce]:PHS:FLISt:DELete	'name'	not-SCPI	3.116

Command	Parameter	SCPI Info	Page
[:SOURce]:PHS:DLISt:CATalog?	⇒name, {name}...	not-SCPI	3.116
[:SOURce]:PHS:SLOT<i>:TYPE	TCHFull | TCHHalf | SYNC | VOX | ADATa	not-SCPI	3.116
[:SOURce]:PHS:SLOT<i>:LEVel	OFF | ATT | FULL	not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>:PRESet		not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>:SCRamble:STATe	ON | OFF	not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>SCRamble:CODE	#HO to #H3FF	not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>:ENCRyption:STATe	ON | OFF	not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>:ENCRyption:KEY	#HO to #HFFFF	not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>:UWORd	#HO to #HFFFFFFFF	not-SCPI	3.117
[:SOURce]:PHS:SLOT<i>:CSID	#HO to #H3FFFFFFFFFF	not-SCPI	3.118
[:SOURce]:PHS:SLOT<i>:PSID	#HO to #HFFFFFFF	not-SCPI	3.118
[:SOURce]:PHS:SLOT<i>:IDLe	#HO to #HFFFFFFF	not-SCPI	3.118
[:SOURce]:PHS:SLOT<i>[:SOURce]:SACChannel	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.118
[:SOURce]:PHS:SLOT<i>[:SOURce]:SACChannel:DLISt	'name'	not-SCPI	3.118
[:SOURce]:PHS:SLOT<i>[:SOURce]:TCH	PN9 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | SDATa	not-SCPI	3.118
[:SOURce]:PHS:SLOT<i>[:SOURce]:TCHannel:DLISt	'name'	not-SCPI	3.118
[:SOURce]:PM1|2[:DEViation]	-360 to +360 deg		3.119
[:SOURce]:PM1|2:EXTernal1|2:COUPling	AC | DC		3.119
[:SOURce]:PM1|2:INTernal:FREQuency	0.1 Hz to1 MHz		3.120
[:SOURce]:PM1|2:SOURce	INTernal | EXTernal1 | EXTernal2		3.120
[:SOURce]:PM1|2:STATe	ON | OFF		3.120
[:SOURce]:POWer:ALC:TABLe[:MEASure]?			3.121
[:SOURce]:POWer:ALC[:STATe]	ON | OFF | AUTO		3.121
[:SOURce]:POWer:ALC:SEARch	ON | OFF | ONCE		3.122
[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]	-144 to+16 dBm		3.122
[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet	-100 to+100		3.122
[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]:RCL	INCLude | EXCLude		3.122
[:SOURce]:POWer:LIMit[:AMPLitude]	-144 to +16 dBm		3.123
[:SOURce]:POWer:MANual	-144 to + 16 dBm		3.123
[:SOURce]:POWer:MODE	FIXed | SWEep | LIST		3.123
[:SOURce]:POWer:PEP?			3.123
[:SOURce]:POWer:STARt	-144 to +16 dBm		3.123
[:SOURce]:POWer:STOP	-144 to +16 dBm		3.123
[:SOURce]:POWer:STEP[:INCRement]	0.1 to 10 dB		3.123
[:SOURce]:PULM:POLarity	NORMal | INVerted		3.124
[:SOURce]:PULM:STATe	ON | OFF		3.124
[:SOURce]:ROSCillator:EXTernal:FREQuency	1 to 16 MHz		3.125
[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]	ON | OFF	not-SCPI	3.125
[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue	0 to 4095	not-SCPI	3.125
[:SOURce]:ROSCillator:SOURce	INTernal | EXTernal	not-SCPI	3.125
[:SOURce]:SWEep:BTIMe	NORMal | LONG	not-SCPI	3.126
[:SOURce]:SWEep[:FREQuency]:DWELl	10 ms to 5 s	not-SCPI	3.126
[:SOURce]:SWEep[:FREQuency]:MODE	AUTO | MANual | STEP	not-SCPI	3.127

Command	Parameter	SCPI Info	Page
[:SOURce]:SWEep[:FREQuency]:POINts	Number	not-SCPI	3.127
[:SOURce]:SWEep[:FREQuency]:SPACing	LINear | LOGarithmic	not-SCPI	3.127
[:SOURce]:SWEep[:FREQuency]:STEP[:LINear	0 to 1 GHz	not-SCPI	3.127
[:SOURce]:SWEep[:FREQuency]:STEP:LOGarithmic	0.01 to 50 PCT	not-SCPI	3.128
[:SOURce]:SWEep:POWer:DWELl	1 ms to 5 s	not-SCPI	3.128
[:SOURce]:SWEep:POWer:MODE	AUTO | MANual | STEP	not-SCPI	3.128
[:SOURce]:SWEep:POWer:POINts	Number	not-SCPI	3.128
[:SOURce]:SWEep:POWer:STEP[:LOGarithmic]	0 to 10 dB	not-SCPI	3.128
[:SOURce]:WCDMa:STATe	ON | OFF	not-SCPI	3.130
[:SOURce]:WCDMa:MODE	CHAN4 | CHAN8 | CHAN15	not-SCPI	3.130
[:SOURce]:WCDMa:PRESet		not-SCPI	3.131
[:SOURce]:WCDMa:CRATe	R4M | R8M	not-SCPI	3.131
[:SOURce]:WCDMa:LINK	DOWN | UP | UPMulti	not-SCPI	3.131
[:SOURce]:WCDMa:FORMat	QPSK | OQPSK	not-SCPI	3.131
[:SOURce]:WCDMa:CRATe:VARiation	100cps to 7.5Mcps	not-SCPI	3.131
[:SOURce]:WCDMa:FILTer:TYPe	SCOSine | COSine | WCDMa	not-SCPI	3.131
[:SOURce]:WCDMa:FILTer:PARameter	0.1 to 0.7	not-SCPI	3.131
[:SOURce]:WCDMa:FILTer:MODE	LACP | LEVM	not-SCPI	3.131
[:SOURce]:WCDMa:LDIStortion[:STATe]	ON | OFF	not-SCPI	3.132
[:SOURce]:WCDMa:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger	not-SCPI	3.132
[:SOURce]:WCDMa:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.132
[:SOURce]:WCDMa:TRIGger:INHibit	0 to 67108863	not-SCPI	3.132
[:SOURce]:WCDMa:TRIGger:DELay	0 to 40959	not-SCPI	3.132
[:SOURce]:WCDMa:TRIGger:OUTPut[1]|2	SLOT | RFRameCSPeriod	not-SCPI	3.132
[:SOURce]:WCDMa:TRIGger:OUTPut[1]|2:POLarity	POSitive | NEGative	not-SCPI	3.132
[:SOURce]:WCDMa:TRIGger:OUTPut[1]|2:DELay	0 to 40959 (81919)	not-SCPI	3.133
[:SOURce]:WCDMa:CLOCk:SOURce	INTernal | EXTernal	not-SCPI	3.133
[:SOURce]:WCDMa:POWer?		not-SCPI	3.133
[:SOURce]:WCDMa:POWer:ADJust		not-SCPI	3.133
[:SOURce]:WCDMa:MULTicode:STATe	ON | OFF63	not-SCPI	3.133
[:SOURce]:WCDMa:MULTicode:MASTer	0 to 3	not-SCPI	3.133
[:SOURce]:WCDMa:MULTicode:CHANnels	#H0 to #H7FF	not-SCPI	3.133
[:SOURce]:WCDMa:SLENgth	1 to 256	not-SCPI	3.133
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:TYPE	PERCh| CCPCh | DPCH | DPDCh | DPCCh | ALL	not-SCPI	3.134
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:SRATe	D16 | D32 | D64 | D128 | D256 | D512 | D1024	not-SCPI	3.134
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:SCODe	0...511	not-SCPI	3.134
[:SOURce]:WCDMa:CHANnel<0...14>:LCODe	#H0 to #H3FFFF (#H1FFFFFFFFFF)	not-SCPI	3.134
[:SOURce]:WCDMa:CHANnel<0...14>:LCODe:OFFSet	0 to 40959 (81919)	not-SCPI	3.134
[:SOURce]:WCDMa:CHANnel<0...14>:SCODe:LMS	#H0 to #HFF	not-SCPI	3.135
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:POWer	-30dB to 0dB	not-SCPI	3.135
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:DATA	PN9 | PN11 | PN15 | PN16 | DLISt	not-SCPI	3.135
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:DATA:DLISt	'name'	not-SCPI	3.135
[:SOURce]:WCDMa:CHANnel<0...14>[:I]|:Q:DATA:OFFSet	0 to 10239	not-SCPI	3.135
[:SOURce]:WCDMa:CHANnel<1...14>:TPC	ZERO | ONE | ALTernate | DLISt	not-SCPI	3.135
[:SOURce]:WCDMa:CHANnel<1...14>:TPC:DLISt	'name'	not-SCPI	3.135

Command	Parameter	SCPI Info	Page
[:SOURce]:WCDMa:CHANnel<0...14>:STATe	ON | OFF	not-SCPI	3.135
[:SOURce]:W3GPp:STATe	ON | OFF	not-SCPI	3.139
[:SOURce]:W3GPp:PRESet		not-SCPI	3.139
[:SOURce]:W3GPp:GPP3:VERSion	V200 | V210	not-SCPI	3.139
[:SOURce]:W3GPp:CRATe	R3M8 | R4M | R8M | R16M	not-SCPI	3.139
[:SOURce]:W3GPp:LINK	FORWard | REVerse	not-SCPI	3.139
[:SOURce]:W3GPp:SETTing:CATalog?		not-SCPI	3.139
[:SOURce]:W3GPp:SETTing:LOAD	'name of sequence'	not-SCPI	3.139
[:SOURce]:W3GPp:SETTing:STORe	'name of sequence'	not-SCPI	3.139
[:SOURce]:W3GPp:SETTing:DELete	'name of sequence'	not-SCPI	3.139
[:SOURce]:W3GPp:PPARameter:PERCh	ON | OFF	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:SCCPch:STATe	ON | OFF	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:SCCPch:SRATe	D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M	not-SCPI	3.140
[:SOURce]:W3GPp a:PPARameter:PRACh:STATe	ON | OFF	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:PRACh:SRATe	D16K | D32K | D64K | D128K	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:DPCCh	ON | OFF	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:DPCH:COUNt	0 to 512	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:DPDCh:COUNt	0 to 512	not-SCPI	3.140
[:SOURce]:W3GPp:PPARameter:SRATe	D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M	not-SCPI	3.141
[:SOURce]:W3GPp:PPARameter:CRESt	MINimum | AVERage | WORSt	not-SCPI	3.141
[:SOURce]:W3GPp:PPARameter:EXECute		not-SCPI	3.141
[:SOURce]:W3GPp:SLENgth	1 to 12	not-SCPI	3.141
[:SOURce]:W3GPp:COPY:SOURce	1 to 4	not-SCPI	3.141
[:SOURce]:W3GPp:COPY:DESTination	1 to 4	not-SCPI	3.141
[:SOURce]:W3GPp:COPY:SOFFset	0 to 2047	not-SCPI	3.141
[:SOURce]:W3GPp:COPY:EXECute		not-SCPI	3.141
[:SOURce]:W3GPp:CLIPping:LEVel	1 to 100PCT	not-SCPI	3.141
[:SOURce]:W3GPp:FILTer:TYPe	SCOSine | COSine | WCDMa	not-SCPI	3.142
[:SOURce]:W3GPp:FILTer:PARameter	0.1 to 0.7	not-SCPI	3.142
[:SOURce]:W3GPp:FILTer:MODE	LACP | LEVM	not-SCPI	3.142
[:SOURce]:W3GPp:CRATe:VARiation	100 Hz to 18 MHz	not-SCPI	3.142
[:SOURce]:W3GPp:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger	not-SCPI	3.142
[:SOURce]:W3GPp:TRIGger:SOURce	EXTernal | INTernal	not-SCPI	3.142
[:SOURce]:W3GPp:TRIGger:INHibit	0 to 67108863	not-SCPI	3.142
[:SOURce]:W3GPp:TRIGger:DELay	0 to 40959	not-SCPI	3.142
[:SOURce]:W3GPp:TRIGger:OUTPut[1]|2	SLOT | RFRame | CSPeriod	not-SCPI	3.143
[:SOURce]:W3GPp:TRIGger:OUTPut[1]|2:POLarity	POSitive | NEGative	not-SCPI	3.143
[:SOURce]:W3GPp:TRIGger:OUTPut[1]|2:DELay	0 to 40959 (81919)	not-SCPI	3.143
[:SOURce]:W3GPp:CLOCk:SOURce	INTernal | EXTernal	not-SCPI	3.143
[:SOURce]:W3GPp:CLOCk:DELay	0 to 0.99	not-SCPI	3.143
[:SOURce]:W3GPp:POWer?		not-SCPI	3.143
[:SOURce]:W3GPp:POWer:ADJust		not-SCPI	3.143
[:SOURce]:W3GPp:DOMain:ERRor[:STAte]?		not-SCPI	3.143
[:SOURce]:W3GPp:BMSTation<i>:STATe	ON | OFF	not-SCPI	3.144

Command	Parameter	SCPI Info	Page
[:SOURce]:W3GPp:BMSTation<i>:LCODe	#H0 to #H3FFFFF (1FFFFFFFFFF)	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:TSECtor	0 to 40959 (163839)	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:SIGNature	0 to 16	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:SOFFset	0 to 15	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:TFCI	0 to 63	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>	ON | OFF	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:SSCG	1 to 34	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:POWer:OFFSet:PSCH	-10.0 to 10.0 dB	not-SCPI	3.144
[:SOURce]:W3GPp:BMSTation<i>:POWer:OFFSet:SSCH	-10.0 to 10.0 dB	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:TPC:MISuse	ON | OFF	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:TPC:POWer:STEP	-10.0 to 10.0 dB	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:POWer	OFF | ANT1 | ANT2	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:FBI	ZERO | ONE | PATTern	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:FBI:PATTern	#H0 to HFFFF	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:FBI:MODE	OFF | BIT1 | BIT2	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:TPC	ZERO | ONE | PATTern	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:TPC:PATTern	#H0 to #HFFFF	not-SCPI	3.145
[:SOURce]:W3GPp:BMSTation<i>:MCHannel:EXECute		not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:SRATe	D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M	not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:SCODe	0 to 2047	not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:POWer	-60 dB to 0 dB	not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:DATA	PN9 | PN11 | PN15 | PN16 | ZERO | ONE | PATTern	not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:DATA:PATTern	#H0 to #HFFFF	not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:DATA:OFFSet	0 to 10239	not-SCPI	3.146
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:TPC	ZERO | ONE | PATTern	not-SCPI	3.147
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:TPC:PATTern	#H0 to #HFFFF	not-SCPI	3.147
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:MCODe	ON | OFF	not-SCPI	3.147
[:SOURce]:W3GPp:BMSTation<i>:CHANnel<n>:STATe	ON | OFF	not-SCPI	3.147
[:SOURce]:W3GPp:MCHannel:STARt	2 to 129	not-SCPI	3.147
[:SOURce]:W3GPp:MCHannel:STOP	2 to 129	not-SCPI	3.147
[:SOURce]:W3GPp:MCHannel:SRATe	D8K | D16K | D32K | D64K | D128K | D256K | D512K | D1M | D2M | D4M	not-SCPI	3.147
[:SOURce]:W3GPp:MCHannel:SCODe	0 to 2047	not-SCPI	3.147
[:SOURce]:W3GPp:MCHannel:SCODe:STEP	0 to 2047	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:POWer	-60 dB to 0 dB	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:POWer:STEP	-60 dB to +60 dB	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:DATA	PN9 | PN11 | PN15 | PN16 | ZERO | ONE | PATTern	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:DATA:PATTern	#H0 to #HFFFF	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:DATA:OFFSet	0 to 40959	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:DATA:OFFSet:STEP	0 to 40959	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:TPC	ZERO | ONE | PATTern	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:TPC:PATTern	#H0 to #HFFFF	not-SCPI	3.148
[:SOURce]:W3GPp:MCHannel:MCODe	ON | OFF	not-SCPI	3.149

Command	Parameter	SCPI Info	Page
[:SOURce]:W3GPp:MCHannel:STATe	ON | OFF	not-SCPI	3.149
:SOURce2:FREQuency[:CW | :FIXed]	40.1 Hz to 1 MHz		3.150
:SOURce2:FREQuency:MANual	0.1 Hz to 1 MHz		3.150
:SOURce2:FREQuency:MODE	CW|FIXed | SWEep		3.151
:SOURce2:FREQuency:STARt	0.1 Hz to 1 MHz		3.151
:SOURce2:FREQuency:STOP	0.1 Hz to 1 MHz		3.151
:SOURce2:MARKer1|2|3[:FSWeep]:AOFF			3.152
:SOURce2:MARKer1|2|3[:FSWeep]:FREQuency	0.1 Hz to 1 MHz		3.152
:SOURce2:MARKer1|2|3[:FSWeep][:STATe]	ON | OFF		3.152
:SOURce2:MARKer1|2|3:POLarity	NORMal | INVerted	not-SCPI	3.152
:SOURce2:SWEep:BTIMe	NORMal | LONG	not-SCPI	3.153
:SOURce2:SWEep[:FREQuency]:DWELl	1 ms to 1 s	not-SCPI	3.153
:SOURce2:SWEep[:FREQuency]:MODE	AUTO | MANual | STEP	not-SCPI	3.153
:SOURce2:SWEep[:FREQuency]:POINts	Number	not-SCPI	3.154
:SOURce2:SWEep[:FREQuency]:SPACing	LINear | LOGarithmic	not-SCPI	3.154
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:SYSTem:MSEQuence:DWELl	50 ms to 60 s{,50 ms to 60 s}	not-SCPI	3.160
:SYSTem:MSEQuence:FREE?		not-SCPI	3.160

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:SYSTem:MSEQuence[:RCL]	1 to 50 {,1 to 50}	not-SCPI	3.160
:SYSTem:MSEQuence[:RCL]:POINts?		not-SCPI	3.161
:SYSTem:MSEQuence:SELect	'Name of sequence'	not-SCPI	3.161
:SYSTem:PRESet			3.161
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:SYSTem:SERRor?		not-SCPI	3.162
:SYSTem:VERSion?		not-SCPI	3.162
:SYSTem:SSAVe	1 to 1000	not-SCPI	3.162
:SYSTem:SREStore	1 to 1000	not-SCPI	3.162
!	<least sign. byte><most sign. byte>	not-SCPI	3.162
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:TEST:DIRect:DGEN	Subaddress {,hex data string}		3.163
:TEST:DIRect:DSYN0MUX	Subaddress {,hex data string}		3.164
:TEST:DIRect:DSYN1MUX	Subaddress {,hex data string}		3.164
:TEST:DIRect:FMOD	Subaddress {,hex data string}		3.164
:TEST:DIRect:IQCON	Subaddress {,hex data string}		3.164
:TEST:DIRect:IQMOD	Subaddress {,hex data string}		3.164
:TEST:DIRect:MCOD	Subaddress {,hex data string}		3.164
:TEST:DIRect:NDSim	Subaddress {,hex data string}		3.164
:TEST:DIRect:ROSC	Subaddress {,hex data string}		3.164
:TEST:DIRect:FSIMA	Subaddress {,hex data string}		3.164
:TEST:RAM?			3.164
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:TEST:BATTery[:RAM]?			3.164
:TEST:BATTery:DGEN?			3.164
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:TRIGger:LIST:SOURce	AUTO | SINGle | EXTernal | HOP	not-SCPI	3.167
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D Annex D

D.1 Programming Examples

The examples explain the programming of the instrument and can serve as a basis to solve more complex programming tasks.

QuickBASIC has been used as programming language. However, the programs can be translated into other languages.

1. Including IEC-Bus Library for QuickBasic

```
REM ----------- Include IEC-bus library for quickbasic ------------
'$INCLUDE: 'c:\qbasic\qbdecl4.bas
```

2. Initialization and Default Status

The IEC bus as well as the settings of the instrument are brought into a defined default status at the beginning of every program. Subroutines "`InitController`" and "`InitDevice`" are used to this effect.

2.1. Initiate Controller

```
REM ------------ Initiate Instrument -----------
REM InitController
iecaddress% = 28                                 'IEC-bus address of the instrument
CALL IBFIND("DEV1", generator%)                  'Open port to the instrument
CALL IBPAD(generator%, iecaddress%)              'Inform controller on instrument address
CALL IBTMO(generator%, 11)                       'Response time to 1 sec
REM ************************************************************************
```

2.2. Initiate Instrument

The IEC-bus status registers and instrument settings of the SMIQ are brought into the default status.

```
REM ------------ Initiate Instrument --------------
REM InitDevice
CALL IBWRT(generator%, "*CLS")                   'Reset status register
CALL IBWRT(generator%, "*RST")                   'Reset instrument
CALL IBWRT(generator%, "OUTPUT ON")              'Switch on RF output
REM************************************************************************
```

3. Transmission of Instrument Setting Commands

Output frequency, output level and AM modulation are set in this example. The settings correspond to the sample setting for first users in manual control. By analogy to the step width setting of the rotary knob, the step width is additionally set for the alteration of the RF frequency in the case of UP and DOWN.

```
REM -------- Instrument setting commands -------------
CALL IBWRT(generator%, "FREQUENCY 250E6")                'RF Frequency 250 MHz
CALL IBWRT(generator%, "POWER -10")                      'Output power -10 dBm
CALL IBWRT(generator%, "AM 80")                          'AM with modulaton index of 80%
CALL IBWRT(generator%, "AM:INTERNAL1:FREQUENCY 3KHZ")    'Modulation frequency 3kHz
CALL IBWRT(generator%, "AM:SOURCE INT")                  'Modulation source LF generator 1
CALL IBWRT(generator%, "FREQUENCY:STEP 12500")           'Step width RF frequency 12.5kHz
REM ***********************************************************************
```

4. Switchover to Manual Control

```
REM -------- Switch instrument over to manual control -----------
CALL IBLOC(generator%)                       'Set instrument to Local state
REM ***********************************************************************
```

5. Reading out Instrument Settings

The settings made in example 3 are read out here. The abbreviated commands are used.

```
REM --------------- Reading out instrument settings -----------------------
RFfrequency$ = SPACE$(20)                      'Provide text variables with 20 characters
CALL IBWRT(generator%, "FREQ?")                'Request frequency setting
CALL IBRD(generator%, RFfrequency$)            'Read value

RFlevel$ = SPACE$(20)                          'Provide text variables with 20 characters
CALL IBWRT(generator%, "POW?")                 'Request level setting
CALL IBRD(generator%, RFlevel$)                'Read value

AMmodulationdepth$ = SPACE$(20)                'Provide text variables with 20 characters
CALL IBWRT(generator%, "AM?")                  'Request setting of modulation depth
CALL IBRD(generator%, AMmodulationdepth$)      'Read value

AMfrequency$ = SPACE$(20)                      'Provide text variables with 20 characters
CALL IBWRT(generator%, "AM:INT:FREQ?")        'Request modulation frequency setting
CALL IBRD(generator%, AMfrequency$)            'Read value

Stepwidth$ = SPACE$(20)                        'Provide text variables with 20 characters
CALL IBWRT(generator%, "FREQ:STEP?")           'Request step width setting
CALL IBRD(generator%, stepwidth$)              'Read value

REM ---------------------- Display values on the screen ---------------
PRINT "RF frequency:        "; RFfrequency$,
PRINT "RF level:            "; RFlevel$,
PRINT "AM modulationdepth:"; AMmodulationdepth$,
PRINT "AM frequency:        "; AMfrequency$,
PRINT "Step width:          "; stepwidth$
REM ***********************************************************************
```

6. List Management

```
REM ----------------------------- Example of list management ------------------------CALL
IBWRT(generator%, "SYST:MSEQ:SELECT "+CHR$(34)+"MSEQ1"+CHR$(34))
                                                   'Select list "MSEQ1", is generated if necessary
CALL IBWRT(generator%, "SYST:MSEQ: 1,3,7,2,5,7,7)                    'Fill RCL list with values
CALL IBWRT(generator%, "SYST:MSEQ:DWELL 0.2")                                   '200ms per step
CALL IBWRT(generator%, "TRIGGER:MSEQ:SOURCE AUTO")    'Permanently repeat MSEQ automatically
CALL IBWRT(generator%, "SYST:MODE MSEQ")                'Switch over instrument to MSEQ mode
REM **********************************************************************
```

7. Command synchronization

The possibilities for synchronization implemented in the following example are described in Section Command Order and Command Synchronization.

```
REM ----------------------- Examples of command synchronization ---------------------
REM Command ROSCILLATOR:SOURCE INT has a relatively long execution time
REM (over 300ms). It is to be ensured that the next command is only executed
REM when the reference oscillator has settled.

REM First possibility: Use of *WAI ---------------------------------------------
CALL IBWRT(generator%, "ROSCILLATOR:SOURCE INT; *WAI; :FREQUENCY 100MHZ")

REM Second possibility: Use of *OPC? -------------------------------------------
OpcOk$ = SPACE$(2)                                   'Space for *OPC? - Provide response
CALL IBWRT(generator%, "ROSCILLATOR:SOURCE INT; *OPC?")
REM ----------- here the controller can service other instruments ----------------------
CALL IBRD(generator%, OpcOk$)                      'Wait for "1" from *OPC?

REM Third possibility: Use of *OPC
REM In order to be able to use the service request function in conjugation with a National
REM Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes"
REM by means of IBCONF.
CALL IBWRT(generator%, "*SRE 32")                  'Permit service request for ESR
CALL IBWRT(generator%, "*ESE 1")                   'Set event-enable bit for operation-complete bit
ON PEN GOSUB OpcReady                              'Initialization of the service request routine
PEN ON
CALL IBWRT(generator%, "ROSCILLATOR:SOURCE INT; *OPC")
REM Continue main program here
STOP                                               'End of program

OpcReady:
REM As soon as the reference oscillator has settled, this subroutine is activated
REM Program suitable reaction to the OPC service request.
ON PEN GOSUB OpcReady                              'Enable SRQ routine again
RETURN
REM **********************************************************************
```

8. Service Request

The service request routine requires an extended initialization of the instrument in which the respective bits of the transition and enable registers are set.
In order to be able to use the service request function in conjugation with a National Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes" by means of IBCONF.

```
REM -------- Example of initialization of the SRQ in the case of errors --------------
CALL IBWRT(generator%, "*CLS")                   'Reset status reporting system
CALL IBWRT(generator%, "*SRE 168")               'Permit service request for STAT:OPER-,
                                                 'STAT:QUES- and ESR register
CALL IBWRT(generator%, "*ESE 60")                'Set event-enable bit for command, execution,
                                                 'device-dependent and query error
CALL IBWRT(generator%, "STAT:OPER:ENAB 32767")   'Set OPERation enable bit for all events
CALL IBWRT(generator%, "STAT:OPER:PTR 32767")    'Set appropriate OPERation Ptransition bits
CALL IBWRT(generator%, "STAT:OPER:ENAB 32767")   'Set questionable enable bits for all events
CALL IBWRT(generator%, "STAT:OPER:PTR 32767")    'Set appropriate questionable Ptransition bits
ON PEN GOSUB Srq                                 'Initialization of the service request routine
PEN ON
REM Continue main program here
STOP                                             'End of program
```

A service request is then processed in the service request routine.

***Note:** The variables userN% and userM% must be pre-assigned usefully.*

```
Srq:
REM -------------------- Service request routine ----------------------------
DO
SRQFOUND% = 0
FOR I% = userN% TO userM%                            'Poll all bus users
ON ERROR GOTO nouser                                 'No user existing
CALL IBRSP(I%, STB%)                                 'Serial poll, read status byte
IF STB% > 0 THE                                      'This instrument has bits set in the STB
SRQFOUND% = 1
IF (STB% AND 16)  > 0 THEN GOSUB Outputqueue
IF (STB% AND 4)   > 0 THEN GOSUB Failure
IF (STB% AND 8)   > 0 THEN GOSUB Questionablestatus
IF (STB% AND 128) > 0 THEN GOSUB Operationstatus
IF (STB% AND 32)  > 0 THEN GOSUB Esrread
END IF
nouser:
NEXT I%
LOOP UNTIL SRQFOUND% = 0
ON ERROR GOTO error handling
ON PEN GOSUB Srq: RETURN                               'Enable SRQ routine again;
'End of SRQ routine
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

```
REM ---------------- Subroutines for the individual STB bits --------------
Outputqueue:                                                'Reading the output buffer
Message$ = SPACE$(100)                                      'Make space for response
CALL IBRD(generator%, Message$)
PRINT "Message in output buffer :"; Message$
RETURN

Failure:                                                     'Read error queue
ERROR$ = SPACE$(100)                                         'Make space for error variable
CALL IBWRT(generator%, "SYSTEM:ERROR?")
CALL IBRD(generator%, ERROR$)
PRINT "Error text :"; ERROR$
RETURN

Questionablestatus:                                         'Read questionable status register
Ques$ = SPACE$(20)                                          'Preallocate blanks to text variable
CALL IBWRT(generator%, "STATus:QUEStionable:EVENt?")
CALL IBRD(generator%, Ques$)
IF (VAL(Ques$) AND 128) > 0 THEN PRINT "Calibration ?"     'Calibration is questionable
IF (VAL(Ques$) AND 1) > 0 THEN PRINT "Voltage ?"           'Output level is questionable
RETURN

Operationstatus:                                            'Read operation status register
Oper$ = SPACE$(20)                                          'Preallocate blanks to text variable
CALL IBWRT(generator%, "STATus:OPERation:EVENt?")
CALL IBRD(generator%, Oper$)
IF (VAL(Oper$) AND 1) > 0 THEN PRINT "Calibration"
IF (VAL(Oper$) AND 2) > 0 THEN PRINT "Settling"
IF (VAL(Oper$) AND 8) > 0 THEN PRINT "Sweeping"
IF (VAL(Oper$) AND 32) > 0 THEN PRINT "Wait for trigger"
RETURN


Esrread:                                                   'Read event status register
Esr$ = SPACE$(20)                                          'Preallocate blanks to text variable
CALL IBWRT(generator%, "*ESR?")                            'Read ESR
CALL IBRD(generator%, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN PRINT "Operation complete"
IF (VAL(Esr$) AND 4) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 8) > 0 THEN PRINT "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 32) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 64) > 0 THEN PRINT "User request"
IF (VAL(Esr$) AND 128) > 0 THEN PRINT "Power on"
RETURN
REM
    **********************************************************************

REM -------------------------- Error routine ------------------------------
Error handling:
PRINT "ERROR"                                             'Output error message
STOP                                                      'Stop software
```

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